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THE DIFFERENTIAL ANALYSIS
OF STARCHES

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INTRODUCTION

Reichert, in his excellent and extensive monograph on starch, gives a historical review dealing with the starch substance, the primary and reverted decomposition products of starch, and the structure, form and mechanism of formation of the starch grain. He outlines the chief forms and classifications of starch grains and has determined in painstaking detail histological, chemical and physical characteristics of 350 starches. For each of these he gives two photomicrographs showing their appearance in ordinary and polarized light.

Extensive tables of the various histological, physical and chemical characteristics are included in Reichert's work. These tables, as they stand, arranged in botanical order, are of limited usefulness to the analytical chemist. For his own convenience the author has rearranged them according to physical and chemical properties and it is thought that thus rearranged they will be found of interest and utility to all who have occasion to deal with starches in an analytical way.

It is sometimes of importance to be able to determine the botanical source from which a certain starch sample is derived. This task, formerly never attempted, is now possible because of Reichert's work. It has become possible not only to tell the difference between starches of different plant families, as corn starch from potato starch, but also to determine between the starches of the members of one family of plants as in the case of wheat, rye and barley; or even to tell whether the starch has come from different varieties of one species—for example, the starch of ginger root from Jamaica, and of ginger root from Cochin China, or between the starches of pod corn, pop corn, flint corn, dent corn, soft corn, sweet corn, and starchy-sweet corn.

Some of these differential determinations may be made by the appearance of the starch grains under the microscope. In some cases chemical analysis will also aid, when, for instance, the percentage of hemicellulose varies between different species as was shown by Ling and Nanji¹ or when the ash is not the same either qualitatively or quantitatively as has been found to be the case in many instances, or when the phosphoric acid present in organic combination varies in different starches, or when the combined fatty acid varies in quantity or quality between the starches.² No

¹ Arthur R. Ling and Dinshaw R. Nanji, Chemical Society of London, *Journal*, CXXIII (1923), 2666-88.

² T. Clinton Taylor and John M. Nelson, American Chemical Society, *Journal*, XLII (Easton, 1920), 1726-38.

doubt the physical properties of starches, such as their qualities of viscosity and water absorption, can also be used in their differentiation.

The investigations of Reichert³ have given us methods which will differentiate between the various starches in a minimum of time with a minimum of materials.

Reichert was able to differentiate between 350 different starches by means of eleven processes of analysis, namely: (1) histological microscopic examination to determine the form and size of the grains, position and character of the hila, characteristics of the lamellae, orientation, etc.; (2) the degree of polarization; (3) the iodine reaction; (4) the gentian violet reaction; (5) the safranin reaction; (6) the temperature of gelatinization; (7) the chloral hydrate-iodine reaction; (8) the chromic acid reaction; (9) the pyrogallol acid reaction; (10) the ferric chloride reaction; and (11) the Purdy solution reaction.

These tests are carried out on small amounts of material by the aid of microscope and require individually not more than one hour's time. Reichert's processes of analysis are summarized at the end of this paper.

PREPARATION OF THE SPECIMEN OF STARCH

Starch, as is well known, constitutes reserve food for the plant and is stored in the leaves, stems, and roots.

Reichert's plant specimens were tubers, rhizomes, bulbs, corms, stalks, fruit, pseudo-tubers, seeds, and in most cases underground parts. A specimen was comminuted by the aid of an ordinary kitchen grater, nutmeg grater, sandpaper, or small drug mill, in accordance with the quantity and physical characters of the specimen. Four or five volumes of water were added to the ground specimen, the mixture thoroughly stirred, the mass strained through four thicknesses of cheesecloth, and the pulp then washed with sufficient water and strained as before. The starch-water preparation is decanted in cylinders and the starch is cleaned by repeated washing and decantation. Finally the starch is collected in shallow dishes, the water as far as possible drained off and the preparation dried at a temperature of 50° C. By this simple means starches can be prepared, which are with rare exceptions practically free from gross impurities; that is, as pure as the nature of Reichert's investigations demanded.

HISTOLOGICAL METHOD

Magnifications ranging from 85 to 400, sometimes higher, are used, according to the size of the grains and incidental conditions. A sufficient amount of dried starch is placed on a slide and mounted in a very dilute Lugol's solution, care being taken not to add a larger quantity of iodine than is sufficient to accentuate the lamellae. Since starches of different sources show wide differences in the intensity with which they become colored with iodine it is found convenient to

³Edward Tyson Reichert, *The Differentiation and Specificity of Starch in Relation to Genera, Species, etc.*, Carnegie Institution of Washington, Publication No. 178, Washington, D.C., 1913; *A Biochemic Basis for the Study of Problems of Taxonomy, Heredity, Evolution, etc.*, Carnegie Institution of Washington, Publication No. 270, Washington, D.C., 1919.

have on hand a number of solutions ranging from 1 to 2 per cent down. By the aid of such ordinary microscope technique there are recorded the form and size of the grains, the position and form of the hilum, or the assumed point of origin of growth or center of organic structure; the form, number and other characteristics of the lamellae; the characteristics pertaining to the form of the grains, whether singly or in doublets, triplets, or aggregates, etc. In describing the grains the terms "proximal end" and "distal end" have been adopted, the former being the end nearer which the hilum is located. The "longitudinal axis" corresponds with an imaginary line, extending from the proximal end through the hilum to the distal end. In different starches and in different grains of the same kind of starch this may be the long or the short axis. The measurements of eccentricity of the hilum have reference to the distance of the hilum from the proximal end of the longitudinal axis.

REACTIONS IN POLARIZED LIGHT WITHOUT AND WITH SELENITE

Starches have been found to exhibit not only marked differences in the degrees with which they rotate the plane of polarized light, but also differences in the characteristics of the "interference figure" or "cross," as it is generally termed. The general characteristics, distinctness, shape, regularity, and position of the interference figure, and also the approximate degree of anisotropy or intensity of polarization were readily studied. By the aid of selenite it was determined whether the optical properties were negative or positive, and also the size, shape and regularity of the quadrants, as well as the intensity and pureness of the blue and yellow colors. In spherical grains with centrally located hila, the two parts of the "cross" intersect at the hilum, or mathematic center, of the grain, so that the term quadrant has a proper application; but in the case of grains having eccentric hila the position of the point of intersection of the two parts of the cross, together with their curvatures, may destroy every semblance of quadrants according to the conventional definition of this word. This term has therefore been used in a very broad sense throughout Reichert's investigation to indicate the four parts of the grain that are defined by the two parts of the cross, in preference to the great multiplicity of terms that would be required to define these parts if great accuracy were attempted. Likewise, for convenience the term "lines" of the interference figure may be used in preference to the "arms" of the cross.

All starches are "optically negative," hence no special references have been made in the text in this particular.¹

The slides for polariscopic examination are prepared as follows: The end of a small spatula is thrust into the specimen of starch and moved about, withdrawn and sharply tapped several times in the center of the slide, and the slide jarred in a manner to cause a practically uniform distribution of the starch grains in a single well-disseminated layer. The margins of this layer are carefully removed so as to leave an area 12 mm. square. An expeditious way of removing the margin so as to insure a uniform area of starch is to use as a wiper a piece of sheet celluloid having a 12 mm. slot, wiping transversely and then longitudinally. A few drops of balsam are carefully added at the center of the area, a cover-slip put on, and the slide placed on the stage of the polarizing microscope. After determining the degree of polarization, the selenite plate is introduced and the specimen again examined.

In order to reduce the degree of polarization into values in comparative terms and figures it was found desirable to adopt an arbitrary scale and to select three

¹The selenite plate enables one to determine the size, shape, and regularity of the quadrants, as well as the intensity and pureness of the blue and yellow colors.

starches as standards that give wide and properly separated gradations of value. Thus, adopting a scale of 100 divided primarily into units of 5, the starch of *Solanum tuberosum* was taken as having a value of 90 and "very high"; that of *Narcissus poeticus ornatus* as having a value of 50, or "moderate"; and that of *Richardia albo-maculata* as having a value of 30, or "low." Intermediate gradations are readily expressed by both words and figures. If the starch examined has, for instance, the same degree of polarization as that of *Narcissus poeticus ornatus* it is given a value of moderate or 50, but if its value be between moderate (50) and high (70) it is recorded as being moderately high (60), or moderate to moderately high (55), or moderately high to high (65). In some instances intermediate values are given where it is necessary to express smaller differences, as between members of a set consisting of parents and hybrid. The different grains of any given specimen of starch vary in the degree of polarization, so that in rating the average must be estimated; as a consequence all of the records are averages. The method is of a very gross character and the personal equation in determining values may be very important and lead to more or less divergent records by different observers, but in practice it has been found that after a degree of skill has been acquired, as common in all such gross methods of experiment, essentially or absolutely the same values are recorded when experiments are repeated several times at well-separated intervals, or made by two individuals who have had practically the same training. Owing to variations in illumination from time to time, it is quite important to use persistently, in conjunction with the starch to be examined, some starch that has been adopted as the standard of comparison, preferably one that has a close value. Thus, when studying the starches of a group, one of the starches is standardized with the starch standard and scale adopted, as before stated, the standard recorded for this starch serving as the fundamental standard for comparison for the others of the group. This method gives very good comparative results, especially when the group consists of a few members; but it is, on the whole, the least valuable of all the methods employed in this research, and its usefulness is chiefly because of its remoteness from the characters of the other methods.

IODINE REACTIONS

The use of iodine not only serves to bring out certain histological peculiarities, but also valuable data in the differentiation of different kinds of starch. The typical or ordinarily observed reaction of starch with iodine is an indigo-blue, but if an excess of iodine be avoided the reaction of the grains will be found to vary usually from a blue to reddish-violet, including within these extremes all shades of violet from a purple to a reddish-violet according to the kind of starch. In fact, in the presence of minute quantities of iodine, starches are colored some shade of violet, varying with the kind of starch. With any quantity of iodine certain starch grains yield a red reaction. In studying the iodine reactions we used 0.125, 0.25, and 2 per cent Lugol's solution. Four serial reactions were studied, two with raw starch and two with gelatinized starch. In the first two, the slides are prepared as in the polarization examinations, substituting solutions of iodine for the balsam and examining the slides in ordinary light with a fully open diaphragm and low power. In the first reaction two drops of 0.25 per cent Lugol's solution are placed on the starch, the slide quickly adjusted on the stage of the microscope, and the color reaction in quality and quantity at once determined, the quantitative value recorded being taken as the standard of comparison in relation to other starches. Here, as in the polarization determinations, it was found necessary to adopt an arbitrary scale and starch standards. The same scale is used as for the polarization values, but the terms "light," "deep," etc., were substituted for "low," "high," etc. Moreover, it was found necessary to modify the selection of starches to be used as standards. The starch of *Solanum*

tuberosum was taken as having a value of 60 or "moderately deep," that of *Crinum Moorei* as having a value of 30 or "light," with corresponding intermediate figures and terms as in the polariscopic determinations.

ANILINE REACTIONS

Aniline colors in solution, especially when in weak solution and exposed to light, are notably unstable, and in order to secure strictly comparable results a quantity of a relatively strong standard solution was prepared and kept in the dark, tightly corked. The stock solutions were composed of 0.25 gm. of aniline with 150 cc. of distilled water. From day to day dilute solutions were prepared by adding 33 cc. of water to 2 cc. of the stock solution; 15 cc. of the latter solution were placed in a test tube containing 0.07 gm. of starch, the preparation agitated, 1 or 2 drops withdrawn in a minute and examined under the microscope, and a final examination made at the end of half an hour. In these color determinations the microscope was used, as in the iodine reactions, with a fully open diaphragm and low power. Owing to the relatively slow reaction, the values for comparative purposes were taken at the end of half an hour instead of immediately, as in the first iodine reaction. The method of valuation is the same as in the iodine reactions, but the starch standards for these reactions are: *Solanum tuberosum*, value 90, "very deep"; *Amaryllis belladonna*, value 50, "moderate"; *Freesia refracta alba*, value 30, "light."

TEMPERATURES OF GELATINIZATION¹

A long quadrangular water bath is used, holding about 4 l. of water; one end is placed over the gas flame, and in the other end is inserted a thermometer which is calibrated in tenths centigrade, but which could readily be read in hundredths. A small quantity of starch with 10 cc. of water is placed in a test tube, into which is inserted, through a perforated cork, a thermometer similar to the one in the water bath, and the test tube immersed in a suspended wire basket in the part of the water bath farthest from the flame. The temperature of the water is raised very slowly, and the water occasionally stirred, so that at no time should the two thermometers differ more than about 2°. As the temperature increases, specimens of the starch are examined at intervals, the tube being shaken, and a specimen obtained by inserting the end of the pipette to the bottom of the tube, a clean pipette being used to remove each specimen. Each specimen is placed on a slide, upon which is recorded both temperatures, and the slide is examined in the *polarizing microscope*. The temperatures at which there is an entire loss of anisotropy of a majority and of all of the grains are recorded as the temperatures of the tube. The lower temperature recorded on the slide is the record of the thermometer in the test tube, and the higher temperature is that of the water bath. The actual temperature of gelatinization lies somewhere between the two, and for convenience, especially for purposes of comparison, the mean of the two was for obvious reasons taken as the "temperature of gelatinization." In the records all three temperatures are given in accordance with the foregoing.

ACTION OF SWELLING REAGENTS

Five such reagents were selected. The choice was made of those which differ widely in chemical composition and yield sufficiently prompt and characteristic

¹It seems probable that another method could be devised in which much smaller amounts of starch could be used. C. W. Mason sends the following reference for the determination of melting points by the aid of the microscope: E. M. Chamot, *Chemical Microscopy*, 1921, chap. ix. Ralph T. K. Cornwell contributes these citations: publications of the United States Bureau of Mines; American Chemical Society, *Journal*, XXXIV (1912), 954, 1,328, XXXIX (1927), 742; and Houben-Weyl, *Die Methoden der organische Chemie*, Erster Band, S. 781 (Zweite Auflage).

results. They are: chloral hydrate-iodine, pyrogallie acid, chromic acid, ferric chloride, and Purdy's solution.

The chloral hydrate-iodine solution is prepared by saturating a saturated solution of chloral hydrate with iodine. The solution, sooner or later, not only causes swelling and ultimate partial dissolution of the grains, but also, owing to the presence of iodine, yields important accompanying color reactions; and it is on the whole to be regarded as a very valuable reagent. Chromic acid is used in the form of a 25 per cent solution, and it is the only one of the five reagents that causes within the periods of observation a complete disintegration of the grains. It gives rise to gas bubbles during the decomposition processes. The pyrogallie acid solution is prepared by making a saturated solution and diluting this with three parts of water, adding oxalic acid in the proportion of 4 per cent to prevent oxidation. The ferric chloride solution consists of equal parts of a saturated solution and water. Purdy's solution is made of equal volumes of the standard solution and water.

Purdy's solution is the least active of the five, and it is, so far as the effect on the grains is concerned, probably essentially an aqueous solution of KOH, and therefore likely possesses no advantages, except perhaps in keeping qualities, over the simple aqueous solution.

Oxygen or exposure to the air favors the action of pyrogallie acid, but hinders those of chloral hydrate and ferric chloride. In the former case the grains near the edge or on the outside of the cover-slip are decidedly more affected than those within, while in the latter the opposite is true.

There are some forms of commercial chloral hydrate that have very little action. The crystals put up by Schering were used throughout Reichert's work.

It is important that fresh solutions of the reagents be prepared at short intervals, as all tend to deteriorate, and it is well to let them stand over night before using.

In using these reagents a small amount of starch is placed on a slide, several drops of the reagent added, a cover glass put on, and the progress of events examined under the microscope. In using a given reagent with a given kind of starch, it was found that there occurred a certain amount of variation in the effects from time to time, which are probably to be attributed chiefly to variations in temperature, so that these studies were made as far as possible under constant temperature conditions.

The variations as a rule were unimportant. These agents give rise to gelatinization and swelling of the grain, and cause the existence of the outer and inner parts of the grains to become very conspicuous—the outer part becoming sac-like and inclosing a less dense or semifluid substance.

In the reactions with the chemical reagents it is essential, in order to obtain uniform and wholly reliable results, that the slides should be prepared with much care as regards the quantity and distribution of the starch and the quantity of the reagent, and that immediately upon the addition of the reagent the preparation be protected so that changes due to alterations in concentration and to oxidation will not occur. The method pursued is as follows:

A square area of starch is first prepared on a slide as in the polarization reactions. This square is surrounded by a layer of purified vaseline 5 mm. wide, applied by an artist's flat camel's hair brush. A cover-slip is now prepared by coating the margin of one surface with a corresponding band of vaseline, so that when the cover-slip is placed on the slide the surfaces of two vaseline squares form an air-tight junction, preventing change in concentration of the reagent by evaporation or absorption of water and eliminating the influence of the oxygen in the atmosphere. Two drops of the reagent are carefully and quickly placed on the center of the starch layer, the cover-slip instantly applied, the slide placed on the stage of the *polarizing microscope*, a suitable field speedily found and

examined in polarized light. Usually a practically exact count is made of the number of grains in view, but if the reaction is very rapid this part of the method is modified as hereinafter stated. All these procedures are done as expeditiously as possible. In the starches of some species there are to be found variable proportions of very minute grains which for obvious reasons must be ignored in making the count. The number of grains in the field ranges usually from 150 to 200, rarely as few as 75 to 100 or as many as 400 to 600, the number depending largely upon and in approximate ratio to the mean size of the grains; but such differences in number do not imply corresponding differences in the total amount of starch present. In specimens in which the grains are small, the number of grains in the field will be larger than when the grains are large, and the number will vary also because of some irregularities in the distribution of the grains, a field always being selected that is well adapted for the count and for watching the processes of gelatinization. Unless gelatinization occurs very rapidly the percentages of grains and total starch gelatinized are not determined until at the end of 5 minutes from the time of the addition of the reagent, and subsequently at 15-, 30-, 45- and 60-minute intervals, or as may be desirable. At these periods the number of grains not completely gelatinized is counted, and then the percentage of grains completely gelatinized is computed by finding the difference between the original number in the field and the number thus found. In addition to the grains completely gelatinized there will be seen grains in partial stages of gelatinization and perhaps some wholly unaffected. The amount of starch remaining ungelatinized is computed in terms of grains and is estimated by finding the number of grains that are unaffected and the proportions of starch ungelatinized in the partially gelatinized grains. Thus, in the latter case, if there remains an average of one-quarter of the starch unaffected (in some grains it may be one-tenth, in others one-fifth, etc.), it will take four grains to represent the amount of starch in an average grain of the specimen, the number thus determined being added to the number of grains that are unaffected and the sum deducted from the original number under observation, computing thus the percentage of the total starch gelatinized.

When gelatinization occurs very rapidly or very slowly the foregoing method must be modified to suit conditions. Frequently complete or almost complete gelatinization occurs within 15 seconds after the application of the reagent. Obviously time is not permitted for a count of the number of grains in the field before determining the number of grains wholly and partially ungelatinized. By extreme alertness it is possible within 15 seconds after the addition of the reagent to have the slide on the stage of the microscope, select a field, make a count of the ungelatinized grains, and estimate the parts of grains that remain ungelatinized. The number of grains in the field cannot be satisfactorily counted after gelatinization because of the swollen and distorted condition and overlapping of the grains. Hence, in these very rapid reactions the average number of grains in a field is determined beforehand and a corresponding field is selected. It follows from this that the percentage of starch gelatinized under such conditions is very grossly estimated, that no importance is to be attached to the figures beyond the time-limit of complete gelatinization, and that the figures have no value for comparison in cases of starches which likewise are very quickly gelatinized, unless by averages obtained from frequently repeated experiments.

When gelatinization occurs very slowly it often is easier, after having made the count in the field, to determine the number of grains gelatinized and partially gelatinized, as for instance when only 1 per cent of the total starch is gelatinized at the end of 5 minutes or 5 or 10 per cent at the end of an hour.

CONSTANCY OF RESULTS RECORDED BY THE FOREGOING METHOD

It goes without saying that such experiments should be carried out as far as possible under fixed conditions, especially as regards the quantity of starch in

relation to the quantity of reagent. The variations in the quantity of starch, in so far as constant results are concerned, are absolutely negligible, as has been found not only in the records of repeated experiments, but also in the records of varieties of a species when the records should be expected to be very close because of the starches being nearly identical. The quantity of reagent used is invariably two drops, each reagent being kept in a 50 cc. bottle having a glass-stoppered finger pipette dropper with a rubber tip. Under practically identical laboratory conditions as regards quantity of starch, quantity of reagent, temperature, and humidity the results recorded by repeated experiments are either identical or vary within limits that are so narrow as to be absolutely without importance. Even marked variations in temperature and humidity have not been found to be important, except in rare instances.

Obviously, some variations, even though trifling, are to be expected, so that in order to obtain *constants* a given experiment should be repeated a sufficient number of times and an average taken of the records, as in the determination of melting-points. Experience has shown, however, that in so far as the requirements of this particular problem are concerned the results of a single experiment carefully carried out are dependable within narrow and wholly unimportant limits of error. The chief sources of error to be guarded against are leakage through the vaseline seal; the presence of contaminating substances in the starch; certain peculiarities occasionally observed in the behavior of starches towards certain reagents; and errors in estimation when the reactions are very rapid. Leakage through the vaseline seal is sedulously to be avoided, and if a leak occurs the slide and records must be discarded.

The presence of oxalate crystals in the starch is by no means uncommon, but no clear evidence has been found to lead to the belief that, unless in exceptionally large quantity, they in any way influence the course or time of gelatinization by the reagents used. Occasionally foreign matter in the form of undetermined débris is present which cannot be gotten rid of by repeated washing, as in *Tritonia Pottsii*. Such matter may affect the polarization, iodine, and aniline reactions to a detectable degree, but no effect has been noted in the other reactions. With the exception of this starch all have been free from such contamination. Finally, when the reactions are very rapid, while satisfactory records may not be obtained for comparison with those of other starches which gelatinize with similar rapidity, changes in the concentrations of the reagents can be made so as to lengthen the time of the reactions and thus permit of satisfactory differentiation.

COMPARATIVE VALUATIONS OF THE REACTION-INTENSITIES

Throughout all of the reactions definite standards of comparison were adopted, varying somewhat with the different agents, yet all forming a definite coordinate system based upon common abscissae. Thus, the reaction-values in the polarization, iodine, gentian violet, and safranin reactions are based upon a "light and color reaction" scale up to 105, from 0 to less than 20 being grouped as very low or very light, 20 to less than 40 as low to light, 40 to less than 60 as moderate, 60 to less than 80 as high or deep, and 80 to 105 as very high or very deep; the terms very low, low, moderate, high, and very high are applied to the polarization reactions; and very light, light, moderate, deep, and very deep to the iodine and aniline reactions, the sets of terms being synonymous in so far as comparative values are concerned. The reactive-values of the temperature of gelatinization experiments range from 42° to 95° C. ("temperature of gelatinization" scale), 82.5° corresponding to 20, 72.5° to 40, 62.5° to 60, 52.5° to 80, and 42.5° to 100, of the foregoing scale. The reaction-values of the reactions with the various chemical reagents are, as previously stated, in terms of complete and partial gelatinization—of complete gelatinization within a period of 60 minutes, and of percentage of total starch gelatinized in 60 minutes, the scale consisting of two

parts in accordance with this division. These reactive-values based upon the light and color scale of 105, are as follows: 50 per cent of the total starch gelatinized in 60 minutes corresponding to 20, and 90 per cent to 40; complete gelatinization in 45 minutes to 60, in 25 minutes to 80, and in 5 minutes to 100.

USE OF THE REICHERT ANALYSIS IN THE DIFFERENTIAL ANALYSIS OF STARCH

For example, a starch sample of unknown origin has been analyzed according to the above-described Reichert methods and found to have the following properties: polarization light to fair, iodine reaction fair to dark, gentian violet reaction zero to very light, safranin reaction zero to very light, temperature of gelatinization 65°, chloral hydrate-iodine reaction 5-10 minutes, chromic acid reaction 0-1 minute, pyrogallie acid reaction 0-5 minutes, ferric chloride reaction 5-10 minutes, and Purdy's reaction 55-60 minutes. If the starch is one of the 350 starches analyzed by Reichert the plant from which it has been derived may be determined by making use of Reichert's tables which have here been rearranged so as to be more readily available for analysis.

On comparison of the light to fair polarization property of the unknown sample of starch with Table A it is found that it may be one of a group of 39 starches. However, the unknown starch has a fair to dark coloration with iodine. If the 39 starches just mentioned be compared with the starches in Table B which have a fair to dark iodine coloration it is found that 18 of the 39 fall in the fair to dark group. The unknown starch has a gentian violet reaction of zero to very light. Of the 18 starches just mentioned there are only four which have an equivalent gentian violet reaction. The unknown starch has a zero to very light reaction with safranin. Of the four starches just mentioned all four have a similar safranin coloration.

To continue the comparison it is found that these four starches all have different temperatures of gelatinization; namely, 85.5°, 65°, 61°, and 58°. The unknown sample has a chloral hydrate-iodine reaction of 5-10 minutes. It is found by comparison in Table F that only one of the four starches, namely, that of *Zea Mays saccharata* (Black Mexican), has a 5-10 minute chloral hydrate-iodine reaction. Therefore the conclusion is that the unknown starch had as its origin *Zea Mays saccharata* (Black Mexican), that is, sweet corn of the Black Mexican variety.

THE DEGREES OF POLARIZATION OF VARIOUS STARCHES

TABLE A

0-VL, zero to very low

Richardia africana
Hedychium Gardnerianum
Marica gracilis

VL-L, very low to low

Triticum sativum var. *vulgare*
Triticum sativum var. *dicoccum*
Pisum sativum var. (Eugenie, green)
Pisum sativum var. (Thos. Laxton)
Tigridia Pavonia var. *grandiflora* alba
Tigridia Pavonia var. *conchiflora*
Musa Cavendishii
Zingiber officinale var. *Jamaica*, No. 1
Zingiber officinale var. *Jamaica*, No. 2
Zingiber officinale var. *Cochin*
Hedychium coronarium
Anemone apennina
Anemone blanda
Aconitum Napellus
Actaea alba
Actaea spicata var. *rubra*
Cimicifuga racemosa
Ranunculus bulbosus

L-F, low to fair

Zea Mays var. *saccharata* (B. Mex.)
Panicum Crus-galli var.
Oryza sativa var.
Secale cereale var. (Mammoth Winter)
Hordeum sativum var. (Champion)
Avena sativa var. (Clydesdale)
Arrhenatherum elatius var.
Dolichos Lablab
Lathyrus sylvestris
Pisum sativum var. (Eugenie, yellow)
Pisum sativum var. (Mam. G. Seeded)
Quercus rubra
Arum palaestinum
Richardia Elliotiana
Richardia albo-maculata
Dieffenbachia seguine var. *nobilis* (cortex)
Dieffenbachia seguine var. *irrorata* (cortex)
Erythronium Dens-canis
Erythronium grandiflorum
Lachenalia pendula
Lachenalia tricolor var. *luteola*
Convallaria majalis
Trillium grandiflorum
Trillium ovatum

Trillium sessile var. *californicum*
Iris florentina
Tritonia crocata
Cypella Herberti
Ixia speciosa
Ixia viridiflora
Babiana var. (violacea)
Babiana var. (Athracton)
Musa Cavendishii (green fruit)
Curcuma longa
Calathea Lietzei
Calathea Wiotiana
Anemone fulgens
Anemone japonica
Cochlearia Armoracia

F-H, fair to high

Zea Mays var. *everta* (Golden Queen)
Zea Mays var. *everta* (White Rice)
Zea Mays var. *indurata* (N. Dakota)
Zea Mays var. *indurata* (C's Early)
Zea Mays var. *indentata* (E'y L'g)
Zea Mays var. *indentata* (H. King)
Zea Mays var. *saccharata* (S's E'n)
Zea Mays var. *saccharata* (G. B'm)
Andropogon Sorghum var. (W. K. Corn)
Andropogon Sorghum var. (Shallu)
Secale cereale var. (Spring)
Vicia sativa
Vicia villosa
Vicia Faba
Phaseolus vulgaris var. (Red K. Bean)
Phaseolus lunatus var. (H's B. Lima)
Lathyrus odoratus var. *Shahzada*
Lathyrus latifolius var. *albus*
Lathyrus magellanicus var. *albus*
Pisum sativum var. (Elec. E. Early)
Pisum sativum var. (L. W. Marrow-fat)
Wistaria chinensis
Arachis hypogaea
Polygonum Fagopyrum var. (American)
Polygonum Fagopyrum var. (Japanese)
Quercus alba
Quercus Muhlenbergii
Quercus Prinus
Quercus texana
Castanea americana
Castanea sativa var. *numbo*
Castanea sativa var.

Castanea pumila
Aesculus Hippocastanum
Arum cornutum
Arum italicum
Arisaema triphyllum
Dracunculus vulgaris
Dieffenbachia seguine var. *nobilis*
 (pith)
Dieffenbachia seguine var. *maculata*
 (cortex)
Dieffenbachia seguine var. *irrorata*
 (pith)
Dieffenbachia illustris (cortex)
Lilium candidum
Lilium longiflorum var. *giganteum*
Lilium longiflorum var. *eximium*
Lilium Parryi
Lilium rubellum
Lilium philadelphicum
Lilium tigrinum var. *splendens*
Lilium auratum
Lilium speciosum var. *album*
Lilium martagon
Lilium superbum
Lilium tenuifolium
Lilium pardalinum
Lilium puberulum
Fritillaria meleagris
Fritillaria pyrenaica
Fritillaria pudica
Fritillaria aurea
Fritillaria armena
Fritillaria imperialis var. *Aurora*
Fritillaria liliacea
Calochortus albus
Calochortus nitidus
Calochortus splendens
Tulipa Hageri
Tulipa sylvestris
Tulipa Greigi
Tulipa Billietiana
Tulipa Didieri
Tulipa Didieri var. *Mauriana*
Tulipa Didieri var. *Fransoniana*
Tulipa Clusiana
Tulipa Clusiana var. *persica*
Tulipa oculus-solis
Tulipa praecox
Tulipa australis
Scilla sibirica
Scilla peruviana
Scilla bifolia
Chionodoxa Lucillae
Chionodoxa Tmolusi
Chionodoxa sardensis
Puschkinia scilloides
Puschkinia scilloides var. *libanotica*
Ornithogalum nutans
Ornithogalum umbellatum
Ornithogalum narbonense (pyrami-
 dale)
Erythronium Dens-canis var. *grand.*

Erythronium americanum
Erythronium citrinum
Erythronium californicum
Hyacinthus orientalis var. *alba*
 superba
Hyacinthus orientalis var. *albulus*
 (Italian)
Muscari botryoides
Muscari paradoxum
Muscari micranthum
Muscari commutatum
Muscari compactum
Muscari comosum
Brodiaea peduncularis
Brodiaea ixioides var. *splendens*
Brodiaea lactea
Brodiaea laxa
Brodiaea coccinea
Brodiaea grandiflora
Brodiaea californica
Brodiaea Purdyi
Brodiaea stellaris
Brodiaea congesta
Triteleia uniflora
Colchicum Parkinsoni
Amaryllis belladonna major
Hippeastrum vittatum
Hippeastrum equestre
Hippeastrum aulicum var. *robustum*
Vallota purpurea
Zephyranthes candida
Zephyranthes rosea
Sprekelia formosissima
Haemanthus Katherinae
Hymenocallis undulata
Leucojum vernum
Leucojum aestivum
Galanthus nivalis
Galanthus Elwesii
Alstroemeria brasiliensis
Sternbergia lutea
Narcissus Horsfieldii
Narcissus maximus
Narcissus Bulbocodium
Narcissus Bulbocodium var. *con-*
 spiciuus
Narcissus Bulbocodium var. *mono-*
 phyllus
Narcissus incomparabilis
Narcissus odorus
Narcissus poeticus
Narcissus biflorus
Narcissus Jonquilla
Narcissus Jonquilla var. *Campernellii*
 rug.
Narcissus tazetta var. *orientalis*
Tacca pinnatifida
Iris pallida var. *speciosa*
Iris pumila var. *cyanea*
Iris Bismarckiana
Iris iberica
Homeria collina

Moraea tristis
Gladiolus byzantinus
Gladiolus primulinus
Gladiolus cardinalis (Blushing Bride)
Gladiolus floribundus
Watsonia humilis
Watsonia iridifolia var. *O'Brieni*
Watsonia Meriana
Tritonia crocata var. *lilacina*
Tritonia crocata var. *rosea*
Tritonia securigera
Tritonia Pottsii
Tritonia crocosmaeflora
Freesia refracta var. *alba*
Freesia refracta var. *Leichtlinii*
Antholyza crocosmoides
Antholyza paniculata
Crocus Susianus (Cloth of Gold)
Crocus versicolor (Cloth of Silver)
Crocus var. (Baron von Brunow)
Romulea rosea var. *speciosa*
Gelasine azurea
Sparaxis grandiflora var. *alba*
Sparaxis var. (Albertine)
Ixia var. (Emma)
Curcuma petiolata
Canna var. (Königin Charlotte)
Canna var. (President Carnot)
Canna var. (L. F. Baily)
Canna var. (Jean Tissot)
Maranta arundinacea
Maranta arundinacea var. No. 1
Maranta arundinacea var. No. 2
Maranta Massangeana
Maranta leuconeura
Maranta musaica
Calathea vittata
Calathea Wiotiana
Stromanthe sanguinea
Nymphaea alba
Nymphaea marliacea var. *albida*
Nymphaea marliacea var. *carnea*
Nymphaea Gladstoniana
Nymphaea odorata
Nymphaea odorata var. *rosea*
Nelumbo nucifera
Nelumbo lutea
Eranthus hyemalis
Ranunculus Ficaria
Cochlearia Armoracia
Manihot utilisima
Cyclamen repandum

Cyclamen coum
Batatas edulis
Gesneria tubiflora
Gloxinia var.
Trianosperma ficifolia
Cycas revoluta
Cycas circinalis
Dioon edule

H-VH, high to very high

Andropogon Sorghum var. (Y. B. Sorgh.)
Vicia fulgens
Vicia Gerardii
Vicia villosa
Vicia Faba
Mucuna pruriens
Lens esculenta
Dieffenbachia seguine var. *maculata* (pith)
Dieffenbachia illustris (pith)
Lilium Henryi
Fritillaria recurva
Calochortus Maweanus var. *major*
Calochortus Benthani
Calochortus lilacinus
Calochortus Leichtlinii
Calochortus luteus var. *oculatus*
Ornithogalum thyrsoides var. *aureum*
Galtonia candicans
Crinum fimbriatulum
Crinum americanum
Alstroemeria brasiliensis
Alstroemeria aurantiaca (aurea)
Narcissus Jonquilla var. *rugulosus*
Iris xiphium var. *Grand Tresorier*
Iris xiphium var. *Wilhelmine*
Iris xiphium var. *lusitanica*
Iris tingitana
Iris reticulata
Iris Histrio
Iris alata
Iris caucasica
Canna Warscewiczii
Canna Roscoeana
Canna edulis
Canna var. (Mrs. Kate Grey)
Canna var. (L. D. Eisele)
Jatropha Curcas
Solanum tuberosum
Zamia integrifolia

THE IODINE REACTIONS OF VARIOUS STARCHES

TABLE B

0-VL, zero to very light coloration
None

VL-L, very light to light coloration
Panicum Crus-galli var.

Oryza sativa var.
Hordeum sativum var. (Champion)
Avena sativa var. (Clydesdale)
Arrhenatherum elatius var.
Pisum sativum var. (Thos. Laxton)

Polygonum Fagopyrum var. (American)
Polygonum Fagopyrum var. (Japanese)
Watsonia humilis
Watsonia Meriana
Tritonia Pottsii
Antholyza crocosmoides
Antholyza paniculata
Romulea rosea var. *speciosa*
Babiana var. (violacea)
Babiana var. (Attraction)
Curcuma longa
Stromanthe sanguinea
Nymphaea Gladstoniana
Manihot utilisima
Zamia integrifolia

L-F, light to fair coloration

Triticum sativum var. *vulgare*
Dolichos Lablab
Lathyrus odoratus var. *Shahzada*
Lathyrus magellanicus var. *albus*
Pisum sativum var. (Eugenie, yellow)
Pisum sativum var. (Eugenie, green)
Pisum sativum var. (Elec. E. Early)
Quercus alba
Quercus Muhlenbergii
Quercus Prinus
Quercus rubra
Quercus texana
Fritillaria armena
Colchicum Parkinsoni
Vallota purpurea
Watsonia iridifolia var. *O'Brieni*
Tritonia crocata
Tritonia securigera
Tritonia crocosmaeflora
Hedychium coronarium
Hedychium Gardnerianum
Curcuma petiolata
Calathea vittata
Calathea Vandenheckei
Nymphaea alba
Nymphaea marliacea var. *albida*
Nymphaea marliacea var. *carnea*
Nymphaea odorata
Nymphaea odorata var. *rosea*

F-D, fair to dark coloration

Zea Mays var. *evarta* (Golden Queen)
Zea Mays var. *evarta* (White Rice)
Zea Mays var. *indurata* (N. Dakota)
Zea Mays var. *indurata* (C.'s Early)
Zea Mays var. *indentata* (E'y L'g)
Zea Mays var. *indentata* (H. King)
Zea Mays var. *saccharata* (S.'s E'n)
Zea Mays var. *saccharata* (B. Mex.)
Zea Mays var. *saccharata* (G. B'm)
Andropogon Sorghum var. (W. K. Corn)

Andropogon Sorghum var. (Y. B. Sorgh.)
Andropogon Sorghum var. (Shallu)
Triticum sativum var. *dicoccum*
Secale cereale var. (Mammoth Winter)
Secale cereale var. (Spring)
Vicia sativa
Vicia villosa
Vicia Faba
Vicia fulgens
Vicia Gerardi
Phaseolus vulgaris var. (Red K. Bean)
Phaseolus limatus var. (H.'s B. Lima)
Mucuna pruriens
Lens esculenta
Lathyrus sylvestris
Lathyrus latifolius var. *albus*
Pisum sativum var. (Mam. G. Seeded)
Pisum sativum var. (L. W. Marrow-fat)
Wistaria chinensis
Arachis hypogaea
Castanea americana
Castanea sativa var. *numbo*
Castanea pumila
Castanea sativa var.
Aesculus Hippocastanum
Arum palaestinum
Arum italicum
Arisaema triphyllum
Richardia Elliotiana
Richardia africana
Dieffenbachia seg. var. *nob.* (pith)
Dieffenbachia seg. var. *nob.* (cort.)
Dieffenbachia seg. var. *irror.* (pith)
Dieffenbachia seg. var. *irror.* (cort.)
Dieffenbachia illustris (cortex)
Lilium candidum
Lilium longiflorum var. *giganteum*
Lilium longiflorum var. *eximium*
Lilium Parryi
Lilium rubellum
Lilium philadelphicum
Lilium Henryi
Lilium auratum
Lilium martagon
Lilium tenuifolium
Lilium pardalinum
Lilium puberulum
Fritillaria meleagris
Fritillaria pyrenaica
Fritillaria pudica
Fritillaria aurea
Fritillaria imperialis var. *Aurora*
Fritillaria liliacea
Fritillaria recurva
Tulipa Hageri
Tulipa Billietiana
Tulipa Didieri
Tulipa Didieri var. *mauriana*
Tulipa Didieri var. *Fransonia*

- Tulipa Clusiana*
Tulipa oculus-solis
Tulipa praecox
Tulipa australis
Scilla sibirica
Scilla peruviana
Scilla bifolia
Chionodoxa Lucillae
Chionodoxa Tmolusi
Chionodoxa sardensis
Puschkinia scilloides
Ornithogalum nutans
Ornithogalum umbellatum
Ornithogalum narbonense (pyrami-
 dale)
Ornithogalum thyrsoides var. *aureum*
Erythronium Dens-canis
Erythronium Dens-canis var. *grand.*
Erythronium americanum
Erythronium grandiflorum
Erythronium citrinum
Erythronium californicum
Hyacinthus orient. var. *alba* *superb.*
Hyacinthus orient. var. *albulus*
 (white)
Hyacinthus orient. var. *albulus*
 (Italian)
Galtonia candicans
Muscari botryoides
Muscari paradoxum
Muscari micranthum
Muscari conicum
Muscari commutatum
Muscari racemosum
Muscari compactum
Muscari comosum
Brodiaea peduncularis
Brodiaea ixioides var. *splendens*
Brodiaea candida
Brodiaea californica
Brodiaea stellaris
Brodiaea congesta
Triteleia uniflora
Lachenalia pendula
Lachenalia tricolor var. *luteola*
Convallaria majalis
Trillium grandiflorum
Trillium sessile var. *californicum*
Amaryllis belladonna *major*
Crinum fimbriatulum
Zephyranthes candida
Zephyranthes rosea
Sprekelia formosissima
Haemanthus Katherinae
Hymenocallis undulata
Leucojum vernum
Galanthus nivalis
Sternbergia lutea
Narcissus Horsfieldii
Narcissus bulbo. var. *monophyllus*
Narcissus incomparabilis
Narcissus Jonquilla
Narcissus tazetta var. *orientalis*
Tacca pinnatifida
Iris florentina
Iris pallida speciosa
Iris pumila var. *cyanea*
Iris Bismarckiana
Iris iberica
Iris xiphium var. *Grand Tresorier*
Iris xiphium var. *Wilhelmine*
Iris xiphium var. *lusitanica*
Iris tingitana
Iris reticulata
Iris Histrio
Iris alata
Iris caucasica
Moraea tristis
Homeria collina
Tigridia Pavonia var. *grand. alba*
Tigridia Pavonia var. *conchiflora*
Gladiolus byzantinus
Gladiolus primulinus
Gladiolus cardinalis (Blush'g Bride)
Gladiolus floribundus
Tritonia crocata var. *lilacina*
Tritonia crocata var. *rosea*
Freesia refracta var. *alba*
Crocus Susianus (Cloth of Gold)
Crocus versicolor (Cloth of Silver)
Crocus var. (Baron von Brunow)
Cypella Herberti
Gelasine azurea
Sparaxis grandiflora *alba*
Sparaxis var. (Albertine)
Ixia speciosa
Ixia viridiflora
Ixia var. (Emma)
Musa Cavendishii
Zingiber officinale
Zingiber offic. var. *Jamaica*, No. 1
Zingiber offic. var. *Jamaica*, No. 2
Zingiber offic. var. *Cochin*
Canna Warscewiczii
Canna musaeifolia
Canna var. (Königin Charlotte)
Canna var. (President Carnot)
Canna var. (L. E. Baily)
Canna var. (Jean Tissot)
Canna var. (J. D. Eisele)
Maranta arundinacea
Maranta arundinacea var. No. 1
Maranta arundinacea var. No. 2
Maranta Massangeana
Maranta leuconeura
Maranta musaica
Calathea Lietzei
Calathea Wiotiana
Nelumbo nucifera
Nelumbo lutea
Comicifuga racemosa
Eranthis hyemalis
Ranunculus bulbosus
Adonis amurensis

Jatropha Curcas
Cyclamen repandum
Gloxinia var.
Cycas revoluta
Cycas circinalis
Dioon edule

D-VD, dark to very dark coloration

Arum cornutum
Dracunculus vulgaris
Richardia albo-maculata
Dieffenbachia seg. var. mac. (pith)
Dieffenbachia seg. var. mac. (cort.)
Dieffenbachia illustris (pith)
Lilium tigrinum var. splendens
Lilium speciosum var. album
Lilium superbum
Calochortus albus
Calochortus Maweanus var. major
Calochortus Benthani
Calochortus lilacinus
Calochortus nitidus
Calochortus Howellii
Calochortus Leichtlinii
Calochortus luteus var. oculatus
Calochortus splendens
Tulipa sylvestris
Tulipa Greigi
Tulipa Clusiana var. persica
Puschkinia scil. var. libanotica
Brodiaea lactea
Brodiaea laxa
Brodiaea coccinea
Brodiaea grandiflora
Brodiaea Purdyi
Brodiaea capitata
Trillium ovatum
Hippeastrum vittatum
Hippeastrum equestre

Hippeastrum aulicum var. robustum
Crinum americanum
Hymenocallis calathina
Leucojum aestivum
Galanthus Elwesii
Alstroemeria ligtu
Alstroemeria brasiliensis
Alstroemeria aurantiaca (aurea)
Narcissus maximus
Narcissus Bulbocodium
Narcissus Bulbo. var. conspicuus
Narcissus odorus
Narcissus poeticus
Narcissus biflorus
Narcissus Jonquilla var. rugulosus
Narcissus Jonquilla var. Campernelli
rug.
Freesia refracta var. Leichtlinii
Musa Cavendishii (green fruit)
Musa sapientum
Musa ensete
Canna Roscoeana
Canna edulis
Canna var. (Mrs. Kate Grey)
Anemone apennina
Anemone fulgens
Anemone blanda
Anemone japonica
Aconitum Napellus
Actaea alba
Actaea spicata var. rubra
Ranunculus Ficaria
Cochlearia Armoracia
Cyclamen coum
Solanum tuberosum
Batatas edulis
Gesneria tubiflora
Trianosperma ficifolia

THE GENTIAN VIOLET REACTIONS
 OF VARIOUS STARCHES

TABLE C

0-VL, zero to very light coloration

Zea Mays var. saccharata (S.'s E'n)
Zea Mays var. saccharata (B. Mex.)
Zea Mays var. saccharata (G. B'm)
Triticum sativum var. vulgare
Triticum sativum var. dicoccum
Hordeum sativum var. (Champion)
Vicia sativa
Vicia villosa
Vicia fulgens
Vicia Gerardi
Pisum sativum var. (Eugenie, yellow)
Pisum sativum var. (Eugenie, green)
Pisum sativum var. (Thos. Laxton)
Polygonum Fagopyrum var. (American)

Polygonum Fagopyrum var. (Japanese)
Quercus alba
Quercus Muhlenbergii
Quercus Prinus
Quercus rubra
Quercus texana
Castanea americana
Castanea sativa var. numbo
Castanea sativa var.
Lilium rubellum
Fritillaria imperialis var. Aurora
Convallaria majalis
Trillium grandiflorum
Trillium ovatum
Trillium sessile var. californicum

Colchicum Parkinsoni
Haemanthus Katherinae
Leucojum vernum
Leucojum aestivum
Gladiolus byzantinus
Gladiolus primulinus
Gladiolus floribundus
Tritonia crocata
Tritonia crocata var. *lilacina*
Tritonia crocata var. *rosea*
Tritonia securigera
Romulea rosea var. *speciosa*
Maranta leuconeura
Calathea Wiotiana
Cimicifuga racemosa
Adonis amurensis
Manihot utilisima

VI-L, very light to light coloration

Zea Mays var. *evarta* (Golden Queen)
Zea Mays var. *evarta* (White Rice)
Zea Mays var. *indurata* (N. Dakota)
Zea Mays var. *indurata* (C.'s Early)
Zea Mays var. *indentata* (E'y L'g)
Zea Mays var. *indentata* (H. King)
Andropogon Sorghum var. (W. K. Corn)
Andropogon Sorghum var. (Y. B. Sorgh.)
Andropogon Sorghum var. (Shallu)
Panicum Crus-galli var.
Oryza sativa var.
Secale cereale var. (Mammoth Winter)
Secale cereale var. (Spring)
Avena sativa var. (Clydesdale)
Arrhenatherum elatius var.
Vicia Faba
Phaseolus vulgaris var. (Red K. Bean)
Phaseolus lunatus var. (H.'s B. Lima)
Dolichos Lablab
Mucuna Pruriens
Lens esculenta
Lathyrus odoratus var. *Shahzada*
Lathyrus sylvestris
Lathyrus latifolius var. *albus*
Pisum sativum var. (Elec. E. Early)
Pisum sativum var. (Mam. G. Seeded)
Pisum sativum var. (L. W. Marrowfat)
Wistaria chinensis
Arachis hypogaea
Aesculus Hippocastanum
Arum palaestinum
Arum italicum
Richardia Elliotiana
Richardia africana
Richardia albo-maculata
Lilium candidum
Lilium longiflorum var. *giganteum*

Lilium longiflorum var. *eximium*
Lilium auratum
Lilium speciosum var. *album*
Lilium martagon
Lilium superbum
Lilium pardalinum
Lilium puberulum
Fritillaria aurea
Fritillaria armena
Puschkinia scilloides
Puschkinia scil. var. *libanotica*
Erythronium Dens-canis
Hyacinthus orientalis var. *albus superbus*
Hyacinthus orientalis var. *albulus* (Italian)
Galtonia candicans
Brodiaea peduncularis
Brodiaea ixioides var. *splendens*
Brodiaea stellaris
Triteleia uniflora
Crinum fimbriatum
Zephyranthes candida
Hymenocallis undulata
Hymenocallis calathina
Narcissus maximus
Narcissus Bulbocodium var. *conspicuus*
Narcissus incomparabilis
Narcissus Jonquilla
Tacca pinnatifida
Iris florentina
Iris pallida speciosa
Iris pumila var. *cyanea*
Iris Bismarckiana
Iris iberica
Moraea tristis
Tigridia Pavonia var. *grand. alba*
Tritonia crocosmaeflora
Crocus Susianus (Cloth of Gold)
Crocus versicolor (Cloth of Silver)
Marica gracilis
Gelasine azurea
Gelasine azurea
Sparaxis grandiflora var. *alba*
Ixia speciosa
Ixia var. (Emma)
Maranta Massangeana
Maranta musaica
Stromanthe sanguinea
Nymphaea alba
Nymphaea marliacea var. *albida*
Nymphaea Gladstoniana
Nymphaea odorata var. *rosea*
Aconitum Napellus
Actaea alba
Actaea spicata var. *rubra*
Ranunculus bulbosus
Zamia integrifolia

L-F, light to fair coloration

Lilium Parryi

Lilium philadelphicum
Lilium tigrinum var. *splendens*
Lilium Henryi
Lilium tenuifolium
Fritillaria meleagris
Fritillaria pudica
Fritillaria liliacea
Calochortus Maweanus var. *major*
Calochortus nitidus
Calochortus splendens
Tulipa Hageri
Tulipa sylvestris
Tulipa Didieri var. *Fransonia*
Scilla sibirica
Scilla bifolia
Chionodoxa Lucillae
Chionodoxa Tmolusi
Chionodoxa sardensis
Puschkinia scilloides var. *libanotica*
Erythronium Dens-canis var. *grand.*
Erythronium americanum
Erythronium grandiflorum
Erythronium citrinum
Erythronium californicum
Hyacinthus orientalis var. *albulus*
 (White)
Muscari commutatum
Brodiaea candida
Brodiaea lactea
Brodiaea laxa
Brodiaea grandiflora
Brodiaea congesta
Lachenalia pendula
Lachenalia tricolor var. *luteola*
Amaryllis belladonna *major*
Vallota purpurea
Crinum americanum
Zephyranthes rosea
Sprekelia formosissima
Sternbergia lutea
Narcissus Horsfieldii
Narcissus Bulbocodium
Narcissus Bulbocodium var. *mono-*
phyllus
Narcissus odoratus
Narcissus poeticus
Narcissus biflorus
Narcissus Jonquilla var. *rugulosus*
Narcissus Jonquilla var. *Campanelli*
rug.
Narcissus tazetta var. *orientalis*
Iris xiphium var. *Grand Tresorier*
Iris xiphium var. *Wilhelmine*
Iris xiphium var. *lusitanica*
Iris tingitana
Iris reticulata
Iris Histrio
Iris alata
Iris caucasica
Hemerocallis collina
Tigridia Pavonia var. *conchiflora*
Gladiolus cardinalis (Blush'g Bride)

Watsonia Meriana
Tritonia Pottsii
Freesia refracta var. *alba*
Antholyza crocosmoides
Antholyza paniculata
Crocus var. (Baron von Brunow)
Cypella Herberti
Sparaxis var. (Albertine)
Ixia viridiflora
Babiana var. (violacea)
Babiana var. (Attraction)
Curcuma longa
Maranta arundinacea
Calathea vittata
Calathea Vandenheckei
Nymphaea marliacea var. *carnea*
Nymphaea odorata
Nelumbo nucifera
Nelumbo lutea
Anemone apennina
Anemone fulgens
Anemone blanda
Cochlearia Armoracia
Batatas edulis
Gloxinia var.
Dioon edule

F-D, fair to dark coloration

Dracunculus vulgaris
Dieffenbachia seg. var. *nob.* (pith)
Dieffenbachia seg. var. *nob.* (cort.)
Dieffenbachia seg. var. *irror.* (cort.)
Dieffenbachia illustris (pith)
Dieffenbachia illustris (cort.)
Fritillaria pyrenaica
Fritillaria recurva
Calochortus albus
Calochortus Benthami
Calochortus lilacinus
Calochortus Howellii
Calochortus Leichtlinii
Calochortus luteus var. *oculatus*
Tulipa Greigi
Tulipa Billietiana
Tulipa Didieri
Tulipa Didieri var. *mauriana*
Tulipa Clusiana
Tulipa Clusiana var. *persica*
Tulipa oculus-solis
Tulipa praecox
Tulipa australis
Scilla peruviana
Ornithogalum nutans
Ornithogalum umbellatum
Ornithogalum narbonne (pyramidale)
Ornithogalum thyrsoides var. *aureum*
Muscari botryoides
Muscari racemosum
Brodiaea coccinea
Brodiaea californica
Brodiaea Purdyi

Brodiaea capitata
Hippeastrum vittatum
Hippeastrum equestre
Hippeastrum aulicum var. *robustum*
Galanthus nivalis
Galanthus Elwesii
Alstroemeria ligtu
Watsonia humilis
Watsonia iridifolia var. *O'Brieni*
Freesia refracta var. *Leichtlinii*
Musa Cavendishii
Musa Cavendishii (green fruit)
Musa ensete
Zingiber officinale
Zingiber officinale var. *Jamaica No. 1*
Zingiber officinale var. *Jamaica No. 2*
Zingiber officinale var. *Cochin*
Hedychium coronarium
Hedychium Gardnerianum
Curcuma petiolata
Canna Warscewiczii
Canna Roscoeana
Canna musaeifolia
Canna edulis
Canna var. (*Königin Charlotte*)
Canna var. (*President Carnot*)
Canna var. (*L. E. Baily*)
Canna var. (*Mrs. Kate Grey*)
Maranta arundinacea var. *No. 1*

Maranta arundinacea var. *No. 2*
Calathea Lietzei
Anemone japonica
Eranthis hyemalis
Ranunculus Ficaria
Jatropha Curcas
Cyclamen repandum
Cyclamen coum
Gesneria tubiflora
Trianosperma ficifolia
Cycas revoluta
Cycas circinalis

D-VD, dark to very dark coloration
Dieffenbachia seg. var. *mac.* (pith)
Dieffenbachia seg. var. *mac.* (cort.)
Dieffenbachia seg. var. *irror.* (pith)
Muscari paradoxum
Muscari micranthum
Muscari conicum
Muscari compactum
Muscari comosum
Alstroemeria brasiliensis
Alstroemeria aurantiaca (aurea)
Musa sapientum
Canna var. (*Jean Tissot*)
Canna var. (*J. D. Eisele*)
Solanum tuberosum

THE SAFRANIN REACTIONS OF VARIOUS STARCHES

TABLE D

0-VL, zero to very light coloration

Zea Mays var. *evarta* (Golden Queen)
Zea Mays var. *evarta* (White Rice)
Zea Mays var. *saccharata* (S.'s E'n)
Zea Mays var. *saccharata* (B. Mex.)
Zea Mays var. *saccharata* (G. B'm)
Hordeum sativum var. (*Champion*)
Pisum sativum var. (*Eugenie, yellow*)
Pisum sativum var. (*Eugenie, green*)
Pisum sativum var. (*Thos. Laxton*)
Quercus alba
Quercus Muhlenbergi
Quercus Prinus
Castanea americana
Castanea sativa var. *numbo*
Castanea sativa var.
Castanea pumila
Arum italicum
Richardia Elliotiana
Richardia africana
Richardia albo-maculata
Lilium longiflorum var. *eximium*
Lilium rubellum
Lilium martagon
Fritillaria armena
Fritillaria imperialis var. *Aurora*
Convallaria majalis
Trillium grandiflorum

Trillium ovatum
Trillium sessile var. *californicum*
Tritoma securigera
Romulea rosea var. *speciosa*
Gelastine azurea
Calathea Wiotiana
Actaea spicata var. *rubra*
Cimicifuga racemosa
Adonis amurensis
Cycas revoluta
Cycas circinalis

VL-L, very light to light coloration

Zea Mays var. *indurata* (N. Dakota)
Zea Mays var. *indurata* (C.'s Early)
Zea Mays var. *indentata* (E'y L'g)
Zea Mays var. *indentata* (H. King)
Andropogon Sorghum var. (W. K. Corn)
Andropogon Sorghum var. (Y. B. Sorgh.)
Andropogon Sorghum var. (Shallu)
Panicum Crus-galli var.
Oryza sativa var.
Triticum sativum var. *vulgare*
Triticum sativum var. *dicoccum*
Secale cereale var. (Mammoth Winter)

Secale cereale var. (Spring)
Avena sativa var. (Clydesdale)
Arrhenatherum elatius var.
Vicia sativa
Vicia villosa
Vicia fulgens
Vicia Gerardi
Phaseolus vulgaris var. (Red K. Bean)
Phaseolus lunatus var. (H.'s B. Lima)
Dolichos Lablab
Mucuna pruriens
Lens esculenta
Lathyrus odoratus var. Shahzada
Lathyrus sylvestris
Lathyrus latifolius var. albus
Pisum sativum var. (Elec. E. Early)
Pisum sativum var. (Mam. G. Seeded)
Pisum sativum var. (L. W. Marrow-fat)
Wistaria chinensis
Arachis hypogaea
Polygonum Fagopyrum var. (American)
Polygonum Fagopyrum var. (Japanese)
Quercus rubra
Quercus texana
Aesculus Hippocastanum
Arum palaestinum
Lilium candidum
Lilium longiflorum var. giganteum
Lilium Parryi
Lilium philadelphicum
Lilium tigrinum var. splendens
Lilium Henryi
Lilium auratum
Lilium speciosum var. album
Lilium superbum
Lilium tenuifolium
Lilium pardalinum
Lilium puberulum
Fritillaria aurea
Tulipa Hageri
Tulipa sylvestris
Puschkinia scilloides
Erythronium Dens-canis
Erythronium Dens-canis var. grand.
Erythronium americanum
Erythronium californicum
Hyacinthus orientalis var. albus superb.
Hyacinthus orientalis var. albulus (Italian)
Colchicum Parkinsoni
Zephyranthes candida
Haemanthus Katherinae
Hymenocallis undulata
Hymenocallis calathina
Leucojum vernum
Leucojum aestivum

Narcissus Bulbocodium
Narcissus Bulbocodium var. conspicuus
Narcissus Bulbocodium var. monophyllus
Narcissus incomparabilis
Narcissus poeticus
Narcissus biflorus
Narcissus Jonquilla
Narcissus Jonquilla var. Campernelli rug.
Tacca pinnatifida
Iris florentina
Iris pallida speciosa
Iris pumila var. cyanea
Iris Bismarckiana
Moraea tristis
Tigridia Pavonia var. grand. alba
Gladiolus primulinus
Watsonia Meriana
Freesia refracta var. alba
Marica gracilis
Sparaxis grandiflora alba
Zingiber officinale
Zingiber officinale var. Jamaica No. 1
Zingiber officinale var. Jamaica No. 2
Zingiber officinale var. Cochin
Maranta leuconeura
Stromanthe sanguinea
Nymphaea Gladstoniana
Nymphaea odorata var. rosea
Anemone apennina
Anemone fulgens
Anemone blanda
Aconitum Napellus
Actaea alba
Ranunculus bulbosus

L-F, light to fair coloration

Vicia Faba
Lathyrus magellanicus var. albus
Arisaema triphyllum
Fritillaria meleagris
Fritillaria pyrenaica
Fritillaria pudica
Fritillaria liliacea
Fritillaria recurva
Tulipa Greigi
Tulipa Billietiana
Tulipa Didieri
Tulipa Didieri var. mauriana
Tulipa Didieri var. Fransoniana
Tulipa Clusiana
Tulipa Clusiana var. persica
Tulipa oculus-solis
Tulipa praecox
Tulipa australis
Puschkinia scilloides var. libanotica
Erythronium grandiflorum
Erythronium citrinum
Hyacinthus orientalis var. albulus (White)

Galtonia candicans
Muscari commutatum
Brodiaea peduncularis
Brodiaea ixioides var. *splendens*
Brodiaea candida
Brodiaea lactea
Brodiaea laxa
Brodiaea californica
Brodiaea stellaris
Brodiaea capitata
Brodiaea congesta
Triteleia uniflora
Lachenalia pendula
Crinum fimbriatulum
Zephyranthes rosea
Narcissus Horsfieldii
Narcissus maximus
Narcissus odoratus
Narcissus Jonquilla var. *rugulosus*
Narcissus tazetta var. *orientalis*
Iris iberica
Iris xiphium var. *Grand Tresorier*
Iris xiphium var. *Wilhelmine*
Iris xiphium var. *lusitanica*
Iris tingitana
Iris reticulata
Iris Histrio
Iris alata
Iris caucasica
Homeria collina
Tigridia Pavonia var. *conchiflora*
Gladiolus byzantinus
Gladiolus cardinalis (Blushing Bride)
Gladiolus floribundus
Tritonia crocata
Tritonia crocata var. *lilacea*
Tritonia crocata var. *rosea*
Tritonia Pottsi
Tritonia crocosmaeflora
Freesia refracta var. *Leichtlinii*
Antholyza crocosmoides
Antholyza paniculata
Crocus Susianus (Cloth of Gold)
Crocus versicolor (Cloth of Silver)
Crocus var. (Baron von Brunow)
Cypella Herberti
Sparaxis var. (Albertine)
Ixia speciosa
Ixia var. (Emma)
Babiana var. (violacea)
Curcuma longa
Maranta Massangeana
Maranta musaica
Calathea vittata
Calathea Vandenheckei
Nymphaea alba
Nymphaea marliacea var. *albida*
Nelumbo nucifera
Nelumbo lutea
Anemone japonica
Cochlearia Armoracia
Cyclamen repandum

Cyclamen coum
Gloxinia var.
Zamia integrifolia

F-D, fair to dark coloration

Arum cornutum
Dracunculus vulgaris
Dieffenbachia seg. var. *nob.* (pith)
Dieffenbachia seg. var. *nob.* (cort.)
Dieffenbachia seg. var. *mac.* (cort.)
Dieffenbachia seg. var. *irror.* (pith)
Dieffenbachia seg. var. *irror.* (cort.)
Dieffenbachia illustris (pith)
Dieffenbachia illustris (cortex)
Calochortus albus
Calochortus Maweanus var. *major*
Calochortus Benthani
Calochortus lilacinus
Calochortus nitidus
Calochortus Howellii
Calochortus Leichtlinii
Calochortus luteus var. *oculatus*
Calochortus splendens
Scilla sibirica
Scilla peruviana
Scilla bifolia
Chionodoxa Lucillae
Chionodoxa Tmolusi
Chionodoxa sardensis
Ornithogalum narbonense (pyrami-
 dale)
Muscari botryoides
Muscari paradoxum
Muscari micranthum
Muscari conicum
Muscari racemosum
Muscari compactum
Muscari comosum
Brodiaea coccinea
Brodiaea grandiflora
Brodiaea Purdyi
Lachenalia tricolor var. *luteola*
Amaryllis belladonna major
Hippeastrum vittatum
Hippeastrum equestre
Hippeastrum alicum var. *robustum*
Vallota purpurea
Crinum americanum
Sprekelia formosissima
Galanthus nivalis
Galanthus Elwesii
Alstroemeria ligta
Sternbergia lutea
Watsonia humilis
Watsonia iridifolia var. *O'Brieni*
Ixia viridiflora
Babiana var. (Attraction)
Musa Cavendishii
Musa Cavendishii (green fruit)
Musa sapientum
Hedychium coronarium
Hedychium Gardnerianum

Curcuma petiolata
Canna Roscoeana
Canna edulis
Canna var. (Königin Charlotte)
Canna var. (President Carnot)
Canna var. (L. E. Baily)
Canna var. (Mrs. Kate Grey)
Maranta arundinacea
Maranta arundinacea var. No. 1
Maranta arundinacea var. No. 2
Calathea Lietzei
Nymphaea marliacea var. carnea
Nymphaea odorata
Eranthis hyemalis
Ranunculus Ficaria
Jatropha Curcas
Manihot utilisima
Batatas edulis

Gesneria tubiflora
Trianosperma ficifolia
Dioon edule

D-VD, dark to very dark coloration
Dieffenbachia seg. var. mac. (pith)
Ornithogalum nutans
Ornithogalum umbellatum
Ornithogalum thyrsoides var. aureum
Alstroemeria brasiliensis
Alstroemeria aurantiaca (aurea)
Musa ensete
Canna Warscewiczii
Canna musaeifolia
Canna var. (Jean Tissot)
Canna var. (J. D. Eisele)
Solanum tuberosum

THE TEMPERATURES OF GELATINIZATION OF VARIOUS STARCHES

TABLE E

	Degrees Centigrade
Fritillaria pudica.....	49.60
Tulipa Greigi.....	50.30
Erythronium citrinum.....	50.45
Calochortus Howellii.....	50.50
Tulipa Didieri.....	50.75
Tulipa Didieri var. mauriana.....	50.95
Tulipa australis.....	51.15
Lilium Parryi.....	52.60
Erythronium Dens-canis.....	52.65
Calochortus albus.....	53.00
Erythronium grandiflorum.....	53.00
Erythronium americanum.....	53.45
Tulipa oculus-solis.....	53.75
Erythronium Dens-canis var. grandiflorum.....	54.00
Tulipa Clusiana var. persica.....	54.75
Alstroemeria aurantiaca (aurea).....	54.75
Calochortus nitidus.....	54.75
Tulipa Didieri var. Fransoniana.....	54.85
Cypella Herberti.....	55.00
Trillium sessile var. californicum.....	55.00
Fritillaria liliacea.....	55.10
Calochortus splendens.....	55.10
Tulipa Billietiana.....	55.25
Ornithogalum narbonense (pyramidale).....	55.50
Tulipa praecox.....	55.80
Lilium Henryi.....	56.00
Puschkinia scilloides.....	56.85
Puschkinia scilloides var. libanotica.....	56.70
Trillium ovatum.....	56.75

24 FIELD MUSEUM OF NATURAL HISTORY—BOTANY, VOL. IX

	Degrees Centigrade
<i>Ornithogalum umbellatum</i>	56.75
<i>Tulipa Hageri</i>	56.90
<i>Tulipa Clusiana</i>	57.10
<i>Tulipa sylvestris</i>	57.15
<i>Lilium tenuifolium</i>	57.30
<i>Alstroemeria brasiliensis</i>	57.75
<i>Erythronium californicum</i>	57.90
<i>Trillium grandiflorum</i>	58.00
<i>Lathyrus sylvestris</i>	58.00
<i>Calochortus luteus</i> var. <i>oculatus</i>	58.10
<i>Alstroemeria ligtu</i>	58.50
<i>Galtonia candicans</i>	58.60
<i>Lilium auratum</i>	58.60
<i>Fritillaria recurva</i>	58.70
<i>Calochortus lilacinus</i>	59.00
<i>Lilium martagon</i>	59.10
<i>Castanea americana</i>	59.25
<i>Calochortus Maweanus</i> var. <i>major</i>	59.50
<i>Fritillaria meleagris</i>	59.50
<i>Castanea pumila</i>	59.75
<i>Tigridia Pavonia</i> var. <i>conchiflora</i>	60.00
<i>Castanea sativa</i> var. <i>numbo</i>	60.00
<i>Chionodoxa Lucillae</i>	60.00
<i>Arrhenatherum elatius</i> var.....	60.25
<i>Lachenalia pendula</i>	60.65
<i>Quercus alba</i>	60.75
<i>Brodiaea laxa</i>	61.00
<i>Convallaria majalis</i>	61.00
<i>Secale cereale</i> var. (Mammoth Winter).....	61.00
<i>Tigridia Pavonia</i> var. <i>grandiflora alba</i>	61.00
<i>Hordeum sativum</i> var. (Champion).....	61.00
<i>Castanea sativa</i> var.....	61.00
<i>Chionodoxa sardensis</i>	61.10
<i>Colchicum Parkinsoni</i>	61.25
<i>Ornithogalum nutans</i>	61.25
<i>Calochortus Benthani</i>	61.50
<i>Lilium superbum</i>	61.60
<i>Lilium candidum</i>	61.65
<i>Brodiaea ixioides</i> var. <i>splendens</i>	61.75
<i>Brodiaea candida</i>	62.00
<i>Secale cereale</i> var. (spring).....	62.00
<i>Lilium tigrinum</i> var. <i>splendens</i>	62.05
<i>Lilium puberulum</i>	62.15
<i>Chionodoxa Tmolusi</i>	62.35
<i>Canna</i> var. (J. D. Eisele).....	62.50
<i>Canna</i> var. (Mrs. Kate Grey).....	62.50
<i>Lilium longiflorum</i> var. <i>giganteum</i>	62.55
<i>Fritillaria aurea</i>	62.75
<i>Triticum sativum</i> var. <i>dicoccum</i>	62.90

	Degrees Centigrade
<i>Calochortus Leichtlinii</i>	63.00
<i>Quercus rubra</i>	63.00
<i>Musa ensete</i>	63.00
<i>Tacca pinnatifida</i>	63.00
<i>Avena sativa</i> var. (Clydesdale)	63.00
<i>Lathyrus latifolius</i> var. <i>albus</i>	63.00
<i>Fritillaria pyrenaica</i>	63.15
<i>Zea Mays</i> var. <i>evarta</i> (White Rice)	63.25
<i>Zea Mays</i> var. <i>evarta</i> (Golden Queen)	63.25
<i>Lilium pardalinum</i>	63.30
<i>Polygonum Fagopyrum</i> var. (American)	63.50
<i>Quercus Muhlenbergii</i>	63.75
<i>Lilium philadelphicum</i>	63.90
<i>Lilium rubellum</i>	63.95
<i>Triticum sativum</i> var. <i>vulgare</i>	64.00
<i>Dracunculus vulgaris</i>	64.25
<i>Quercus texana</i>	64.25
<i>Lilium speciosum</i> var. <i>album</i>	64.35
<i>Brodiaea lactea</i>	64.50
<i>Iris caucasica</i>	64.50
<i>Scilla bifolia</i>	64.75
<i>Quercus Prinus</i>	64.75
<i>Polygonum Fagopyrum</i> var. (Japanese)	64.75
<i>Zea Mays</i> var. <i>saccharata</i> (Black Mexican)	65.00
<i>Vicia Faba</i>	65.00
<i>Canna</i> var. (Königin Charlotte)	65.25
<i>Iris reticulata</i>	65.25
<i>Iris xiphium</i> var. <i>Grand Tresorier</i>	65.50
<i>Iris tingitana</i>	65.50
<i>Canna</i> var. (President Carnot)	65.50
<i>Scilla peruviana</i>	65.50
<i>Iris Histrio</i>	65.50
<i>Brodiaea capitata</i>	65.57
<i>Lilium longiflorum</i> var. <i>eximium</i>	65.60
<i>Brodiaea grandiflora</i>	65.90
<i>Scilla sibirica</i>	66.00
<i>Vicia villosa</i>	66.00
<i>Ornithogalum thyrsoides</i> var. <i>aureum</i>	66.00
<i>Iris xiphium</i> var. <i>Wilhelmine</i>	66.50
<i>Galanthus nivalis</i>	66.50
<i>Arachis hypogaea</i>	66.50
<i>Iris alata</i>	66.50
<i>Zea Mays</i> var. <i>indentata</i> (Early Leaming)	66.50
<i>Zea Mays</i> var. <i>saccharata</i> (Golden Bantam)	66.50
<i>Fritillaria armena</i>	66.60
<i>Zea Mays</i> var. <i>indentata</i> (Hickory King)	66.75
<i>Zea Mays</i> var. <i>saccharata</i> (Stowell's Evergreen)	66.85
<i>Andropogon Sorghum</i>	66.90
<i>Hyacinthus orientalis</i> var. <i>albus superbissimus</i>	67.00

	Degrees Centigrade
<i>Iris xiphium</i> var. <i>lusitanica</i>	67.00
<i>Brodiaea Purdyi</i>	67.00
<i>Brodiaea californica</i>	67.30
<i>Musa Cavendishii</i> (green fruit).....	67.50
<i>Canna edulis</i>	67.50
<i>Musa Cavendishii</i>	67.75
<i>Andropogon Sorghum</i> var. (White Kaffir Corn).....	68.00
<i>Musa sapientum</i>	68.00
<i>Muscari comosum</i>	68.00
<i>Zea Mays</i> var. <i>indurata</i> (North Dakota).....	68.00
<i>Brodiaea stellaris</i>	68.10
<i>Fritillaria imperialis</i> var. <i>Aurora</i>	68.40
<i>Lathyrus odoratus</i> var. <i>Shahzada</i>	68.50
<i>Hymenocallis calathina</i>	68.50
<i>Pisum sativum</i> var. (Large White Marrowfat).....	68.50
<i>Brodiaea peduncularis</i>	68.50
<i>Zea Mays</i> var. <i>indurata</i> (Compton's Early).....	68.50
<i>Dieffenbachia seguine</i> var. <i>irrorata</i> (cortex).....	68.75
<i>Aesculus Hippocastanum</i>	69.00
<i>Dieffenbachia seguine</i> var. <i>irrorata</i> (pith).....	69.00
<i>Dieffenbachia seguine</i> var. <i>nobilis</i> (pith).....	69.00
<i>Lathyrus magellanicus</i> var. <i>albus</i>	69.00
<i>Dieffenbachia seguine</i> var. <i>nobilis</i> (cortex).....	69.00
<i>Maranta Massangeana</i>	69.00
<i>Hyacinthus orientalis</i> var. <i>albulus</i> (White).....	69.00
<i>Canna Warscewiczii</i>	69.00
<i>Canna</i> var. (L. E. Baily).....	69.00
<i>Brodiaea congesta</i>	69.25
<i>Triteleia uniflora</i>	69.45
<i>Dieffenbachia illustris</i> (pith).....	69.50
<i>Canna Roscoeana</i>	69.50
<i>Hyacinthus orientalis</i> var. <i>albulus</i> (Italian).....	69.50
<i>Muscari micranthum</i>	69.75
<i>Crocus Susianus</i> (Cloth of Gold).....	70.00
<i>Pisum sativum</i> var. (Electric Extra Early).....	70.00
<i>Arum cornutum</i>	70.00
<i>Brodiaea coccinea</i>	70.00
<i>Moraea tristis</i>	70.00
<i>Canna</i> var. (Jean Tissot).....	70.00
<i>Muscari compactum</i>	70.00
<i>Arisaema triphyllum</i>	70.00
<i>Dieffenbachia illustris</i> (cortex).....	70.00
<i>Marica gracilis</i>	70.00
<i>Galanthus Elwesii</i>	70.00
<i>Andropogon Sorghum</i> var. (Yellow Branching Sorghum).....	70.00
<i>Canna musaeifolia</i>	70.50
<i>Arum palaestinum</i>	70.50
<i>Dieffenbachia seguine</i> var. <i>maculata</i> (pith).....	70.50
<i>Pisum sativum</i> var. (Mammoth Gray Seeded).....	70.50

	Degrees Centigrade
<i>Dieffenbachia seguine</i> var. <i>maculata</i> (cortex)	70.60
<i>Vicia Gerardi</i>	71.00
<i>Muscari botryoides</i>	71.00
<i>Hedychium Gardnerianum</i>	71.15
<i>Wistaria chinensis</i>	71.50
<i>Sparaxis grandiflora alba</i>	71.50
<i>Hymenocallis undulata</i>	71.50
<i>Leucojum vernum</i>	71.50
<i>Iris florentina</i>	71.50
<i>Hippeastrum aulicum</i> var. <i>robustum</i>	71.75
<i>Iris Bismarckiana</i>	72.00
<i>Antholyza paniculata</i>	72.00
<i>Maranta arundinacea</i> var. No. 2	72.00
<i>Hippeastrum vittatum</i>	72.00
<i>Narcissus Bulbocodium</i>	72.00
<i>Vicia fulgens</i>	72.00
<i>Muscari commutatum</i>	72.00
<i>Arum italicum</i>	72.00
<i>Lens esculenta</i>	72.25
<i>Hedychium coronarium</i>	72.30
<i>Vicia sativa</i>	72.50
<i>Homeria collina</i>	72.50
<i>Hippeastrum equestre</i>	72.50
<i>Sparaxis</i> var. (Albertine)	72.50
<i>Leucojum aestivum</i>	72.50
<i>Maranta arundinacea</i> var. No. 1	72.50
<i>Tritonia Pottsii</i>	72.50
<i>Narcissus Bulbocodium</i> var. <i>conspicuus</i>	72.75
<i>Tritonia crocosmaeflora</i>	73.00
<i>Muscari paradoxum</i>	73.00
<i>Zephyranthes candida</i>	73.00
<i>Muscari conicum</i>	73.00
<i>Lachenalia tricolor</i> var. <i>luteola</i>	73.10
<i>Iris iberica</i>	73.10
<i>Pisum sativum</i> var. (Thomas Laxton)	73.25
<i>Iris pumila</i> var. <i>cyanea</i>	73.25
<i>Narcissus poeticus</i>	73.25
<i>Romulea rosea</i> var. <i>speciosa</i>	73.50
<i>Gelasine azurea</i>	73.50
<i>Pisum sativum</i> var. (Eugenie, yellow)	73.50
<i>Zingiber officinale</i>	73.85
<i>Narcissus Horsfieldii</i>	74.00
<i>Amaryllis belladonna major</i>	74.00
<i>Narcissus Bulbocodium</i> var. <i>monophyllus</i>	74.00
<i>Mucuna pruriens</i>	74.00
<i>Antholyza crocosmoides</i>	74.00
<i>Maranta leuconeura</i>	74.00
<i>Crocus</i> var. (Baron von Brunow)	74.00
<i>Vallota purpurea</i>	74.25

28 FIELD MUSEUM OF NATURAL HISTORY—BOTANY, VOL. IX

	Degrees Centigrade
<i>Pisum sativum</i> var. (Eugenie, green)	74.50
<i>Phaseolus vulgaris</i> var. (Red Kidney Bean)	74.50
<i>Watsonia iridifolia</i> var. O'Brieni	74.50
<i>Narcissus odoratus</i>	74.50
<i>Iris pallida speciosa</i>	74.50
<i>Oryza sativa</i> var.	74.75
<i>Muscari racemosum</i>	74.75
<i>Richardia africana</i>	75.00
<i>Narcissus biflorus</i>	75.00
<i>Crocus versicolor</i> (Cloth of Silver)	75.00
<i>Panicum Crus-galli</i> var.	75.25
<i>Narcissus Jonquilla rugulosus</i>	75.25
<i>Narcissus maximus</i>	75.25
<i>Sternbergia lutea</i>	75.50
<i>Watsonia humilis</i>	75.50
<i>Zephyranthes rosea</i>	76.00
<i>Crinum fimbriatulum</i>	76.00
<i>Narcissus Jonquilla</i>	76.00
<i>Richardia Elliotiana</i>	76.00
<i>Watsonia Meriana</i>	76.25
<i>Narcissus incomparabilis</i>	76.25
<i>Gladiolus cardinalis</i> (Blushing Bride)	76.50
<i>Narcissus Jonquilla Campernelli rugulosus</i>	76.50
<i>Freesia refracta</i> var. <i>alba</i>	76.75
<i>Maranta arundinacea</i>	77.00
<i>Narcissus tazetta</i> var. <i>orientalis</i>	77.00
<i>Sprekelia formosissima</i>	77.00
<i>Crinum americanum</i>	77.00
<i>Freesia refracta</i> var. <i>Leichtlinii</i>	77.25
<i>Richardia albo-maculata</i>	77.50
<i>Gladiolus byzantinus</i>	78.50
<i>Dolichos Lablab</i>	79.50
<i>Phaseolus lunatus</i> var. (Henderson's Bush Lima)	79.75
<i>Haemanthus Katherinae</i>	80.00
<i>Babiana</i> var. <i>violacea</i>	80.00
<i>Gladiolus primulinus</i>	80.50
<i>Tritonia securigera</i>	81.00
<i>Gladiolus floribundus</i>	81.00
<i>Tritonia crocata</i> var. <i>rosea</i>	81.50
<i>Tritonia crocata</i> var. <i>lilacina</i>	81.75
<i>Babiana</i> var. (Athraxion)	82.00
<i>Zingiber officinale</i> var. <i>Jamaica No. 1</i>	82.25
<i>Curcuma petiolata</i>	82.50
<i>Tritonia crocata</i>	82.50
<i>Curcuma longa</i>	82.50
<i>Ixia viridiflora</i>	83.00
<i>Ixia speciosa</i>	84.00
<i>Ixia</i> var. (Emma)	84.50
<i>Zingiber officinale</i> var. <i>Jamaica No. 2</i>	85.90
<i>Zingiber officinale</i> var. <i>Cochin</i>	90.00

THE CHLORAL HYDRATE-IODINE REACTIONS OF VARIOUS STARCHES

TABLE F

0-5, zero to five minutes for gelatinization

Zea Mays var. *everta* (Golden Queen)
Zea Mays var. *everta* (White Rice)
Pisum sativum var. (Eugenie, yellow)
Pisum sativum var. (Eugenie, green)
Pisum sativum var. (Thos. Laxton)
Wistaria chinensis
Arachis hypogaea
Polygonum Fagopyrum var. (American)
Polygonum Fagopyrum var. (Japanese)
Quercus alba
Quercus Prinus
Quercus rubra
Quercus texana
Castanea americana
Castanea sativa var. *numbo*
Castanea sativa var.
Castanea pumila
Arum cornutum
Richardia africana
Lilium Parryi
Lilium tigrinum var. *splendens*
Lilium speciosum var. *album*
Lilium martagon
Lilium pardalinum
Fritillaria meleagris
Fritillaria pudica
Fritillaria liliacea
Calochortus Benthani
Calochortus lilacina
Calochortus nitidus
Ornithogalum thyrsoides var. *aureum*
Erythronium Dens-canis
Erythronium Dens-canis var. *grand.*
Erythronium americanum
Erythronium grandiflorum
Erythronium citrinum
Hyacinthus orientalis var. *alba* superb.
Hyacinthus orientalis var. *albulus* (White)
Convallaria majalis
Trillium grandiflorum
Trillium ovatum
Trillium sessile var. *californicum*
Haemanthus Katherinae
Hymenocallis calathina
Iris florentina
Iris Bismarckiana
Crocus Susianus (Cloth of Gold)
Crocus var. (Baron von Brunow)
Sparaxis grandiflora *alba*
Sparaxis var. (Albertine)
Musa Cavendishii

Musa Cavendishii (green fruit)
Musa sapientum
Zingiber officinale
Hedychium coronarium
Hedychium Gardnerianum
Canna Warscewiczii
Canna Roscoeana
Canna edulis
Canna var. (Königin Charlotte)
Canna var. (President Carnot)
Canna var. (L. E. Baily)
Canna var. (Mrs. Kate Grey)
Canna var. (Jean Tissot)
Canna var. (J. D. Eisele)
Nelumbo nucifera
Nelumbo lutea
Anemone apennina
Anemone fulgens
Anemone blanda
Anemone japonica
Aconitum Napellus
Actaea alba
Actaea spicata var. *rubra*
Cimicifuga racemosa
Eranthis hyemalis
Ranunculus bulbosus
Ranunculus Ficaria
Adonis amurensis
Cochlearia Armoracia
Jatropha Curcas
Cyclamen repandum
Cyclamen coum
Gloxinia var.
Trianosperma ficifolia

5-10, five to ten minutes for gelatinization

Zea Mays var. *indurata* (N. Dakota)
Zea Mays var. *indurata* (C.'s Early)
Zea Mays var. *indentata* (E'y L'g)
Zea Mays var. *indentata* (H. King)
Zea Mays var. *saccharata* (S.'s E'n)
Zea Mays var. *saccharata* (B. Mex.)
Zea Mays var. *saccharata* (G. B'm)
Secale cereale var. (spring)
Avena sativa var. (Clydesdale)
Arrhenatherum elatius var.
Quercus Muhlenbergii
Aesculus Hippocastanum
Arum palaestinum
Dracunculus vulgaris
Richardia albo-maculata
Lilium longiflorum var. *eximium*
Lilium rubellum
Lilium philadelphicum
Lilium superbum

Lilium tenuifolium
Fritillaria pyrenaica
Fritillaria aurea
Fritillaria armena
Calochortus albus
Calochortus Maweanus var. major
Calochortus Howellii
Calochortus Leichtlinii
Calochortus luteus var. *oculatus*
Calochortus splendens
Tulipa Hageri
Tulipa Greigi
Tulipa Clusiana
Tulipa Clusiana var. *persica*
Tulipa oculus-solis
Tulipa australis
Chionodoxa Tmolusi
Puschkinia scilloides
Ornithogalum nutans
Ornithogalum umbellatum
Ornithogalum narbonense (pyrami-
 dale)
Erythronium californicum
Galtonia candicans
Amaryllis belladonna major
Sprekelia formosissima
Hymenocallis undulata
Alstroemeria ligtu
Alstroemeria brasiliensis
Tigridia Pavonia var. *conchiflora*
Crocus versicolor (Cloth of Silver)
Musa ensete
Curcuma longa
Curcuma petiolata
Canna musaeifolia

10-15, ten to fifteen minutes for
gelatinization

Andropogon Sorghum var. (W. K.
 Corn)
Andropogon Sorghum var. (Y. B.
 Sorgh.)
Panicum Crus-galli var.
Dieffenbachia seg. var. nob. (cort.)
Lilium candidum
Lilium longiflorum var. *giganteum*
Lilium Henryi
Lilium puberulum
Fritillaria imperialis var. *Aurora*
Fritillaria recurva
Tulipa sylvestris
Tulipa Billietiana
Tulipa Didieri var. *Fransoniana*
Scilla sibirica
Scilla peruviana
Scilla bifolia
Chionodoxa Lucillae
Chionodoxa sardensis
Puschkinia scilloides var. *libanotica*
Hyacinthus orient. var. *albulus*
 (Italian)
Crinum americanum

Galanthus nivalis
Iris pallida speciosa
Iris pumila var. *cyanea*
Iris iberica
Iris xiphium var. *Grand Tresorier*
Iris xiphium var. *Wilhelmine*
Iris xiphium var. *lusitanica*
Iris caucasica
Tigridia Pavonia var. *grand. alba*
Gladiolus floribundus
Watsonia iridifolia var. *O'Brieni*
Stromanthe sanguinea

15-20, fifteen to twenty minutes for
gelatinization

Andropogon Sorghum var. (Shallu)
Oryza sativa
Secale cereale var. (Mammoth
 Winter)
Richardia Elliotiana
Lilium auratum
Tulipa Didieri
Tulipa Didieri var. *mauriana*
Tulipa praecox
Muscari botryoides
Muscari micranthum
Alstroemeria aurantiaca (aurea)
Watsonia humilis
Watsonia Meriana

20-25, twenty to twenty-five minutes
for gelatinization

Dieffenbachia seg. var. *irror.* (cort.)
Iris tingitana
Tritonia crocata
Tritonia crocata var. *rosea*

25-30, twenty-five to thirty minutes
for gelatinization

Lathyrus sylvestris
Lathyrus latifolius var. *albus*
Arum italicum
Arisaema triphyllum
Dieffenbachia seg. var. nob. (pith)
Muscari commutatum
Muscari compactum
Muscari comosum
Lachenalia pendula
Crinum fimbriatulum
Leucojum vernum
Leucojum aestivum
Galanthus Elwesii
Iris alata
Tritonia crocata var. *lilacina*
Tritonia securigera
Cypella Herberti
Ixia speciosa
Ixia viridiflora
Ixia var. (Emma)
Nymphaea odorata var. *rosea*

30-35, thirty to thirty-five minutes
for gelatinization

Brodiaea candida
Brodiaea laxa

35-40, thirty-five to forty minutes for
gelatinization

Dieffenbachia seg. var. *irror.* (pith)
Iris reticulata

40-45, forty to forty-five minutes for
gelatinization

Brodiaea lactea
Lachenalia tricolor var. *luteola*
Narcissus Jonquilla
Solanum tuberosum

45-50, forty-five to fifty minutes for
gelatinization

Muscari racemosum
Colchicum Parkinsoni
Hippeastrum aulicum var. *robustum*

50-55, fifty to fifty-five minutes for
gelatinization

None

55-60, fifty-five to sixty minutes for
gelatinization

Triticum sativum var. *vulgare*
Triticum sativum var. *dicoccum*
Hordeum sativum var. (Champion)
Vicia sativa
Vicia villosa
Vicia Faba
Vicia fulgens
Vicia Gerardi
Phaseolus vulgaris var. (Red K.
Bean)
Phaseolus lunatus var. (H.'s B. Lima)
Dolichos Lablab
Mucuna pruriens
Lens esculenta
Lathyrus odoratus var. *Shahzada*
Lathyrus magellanicus var. *albus*
Pisum sativum var. (Elec. E. Early)
Pisum sativum var. (Mam. G.
Seeded)
Pisum sativum var. (L. W. Marrow-
fat)
Dieffenbachia seg. var. *mac.* (pith)
Dieffenbachia seg. var. *mac.* (cort.)
Dieffenbachia illustris (pith)
Dieffenbachia illustris (cortex)
Muscari paradoxum
Muscari conicum
Brodiaea peduncularis
Brodiaea ixioides var. *splendens*
Brodiaea coccinea
Brodiaea grandiflora

Brodiaea californica
Brodiaea Purdyi
Brodiaea stellaris
Brodiaea capitata
Brodiaea congesta
Triteleia uniflora
Hippeastrum vittatum
Hippeastrum equestre
Vallota purpurea
Zephyranthes candida
Zephyranthes rosea
Sternbergia lutea
Narcissus Horsfieldii
Narcissus maximus
Narcissus Bulbocodium
Narcissus Bulbocodium var. *con-*
spicuus
Narcissus Bulbocodium var. *mono-*
phyllus
Narcissus incomparabilis
Narcissus odoratus
Narcissus poeticus
Narcissus biflorus
Narcissus Jonquilla var. *rugulosus*
Narcissus Jonquilla var. *Campanelli*
rug.
Narcissus tazetta var. *orientalis*
Tacca pinnatifida
Iris Histrio
Moraea tristis
Homeria collina
Gladiolus byzantinus
Gladiolus primulinus
Gladiolus cardinalis (Blushing Bride)
Tritonia Pottsii
Tritonia crocosmaeflora
Freesia refracta var. *alba*
Freesia refracta var. *Leichtlinii*
Antholyza crocosmoides
Antholyza paniculata
Romulea rosea var. *speciosa*
Marica gracilis
Gelasine azurea
Babiana var. (violacea)
Babiana var. (Athraxion)
Zingiber officinale var. *Jamaica No. 1*
Zingiber officinale var. *Jamaica No. 2*
Zingiber officinale var. *Cochin*
Maranta arundinacea
Maranta arundinacea var. *No. 1*
Maranta arundinacea var. *No. 2*
Maranta Massangeana
Maranta leuconeura
Maranta musaica
Calathea Lietzei
Calathea vittata
Calathea Wiotiana
Calathea Vandenheckei
Nymphaea alba
Nymphaea marliacea var. *albida*
Nymphaea marliacea var. *carnea*
Nymphaea Gladstoniana

Nymphaea odorata
Manihot utilisima
Batatas edulis
Gesneria tubiflora

Cycas revoluta
Cycas circinalis
Dioon edule
Zamia integrifolia

THE CHROMIC ACID REACTIONS OF VARIOUS STARCHES

TABLE G

0-1, zero to one minute for gelatini-
zation

Zea Mays var. *indentata* (H. King)
Zea Mays var. *saccharata* (B. Mex.)
Avena sativa var. (Clydesdale)
Arrhenatherum elatius var.
Wistaria chinensis
Polygonum Fagopyrum var. (Ameri-
can)
Polygonum Fagopyrum var. (Japa-
nese)
Quercus alba
Quercus Muhlenbergii
Quercus rubra
Quercus texana
Castanea americana
Castanea sativa var. *numbo*
Castanea sativa var.
Castanea pumila
Aesculus Hippocastanum
Lilium candidum
Lilium longiflorum var. *giganteum*
Lilium longiflorum var. *eximium*
Lilium Parryi
Lilium rubellum
Lilium philadelphicum
Lilium tigrinum var. *splendens*
Lilium Henryi
Lilium speciosum var. *album*
Lilium martagon
Lilium superbum
Lilium tenuifolium
Lilium pardalinum
Lilium puberulum
Fritillaria meleagris
Fritillaria pyrenaica
Fritillaria pudica
Fritillaria aurea
Fritillaria armena
Fritillaria imperialis var. *Aurora*
Fritillaria liliacea
Fritillaria recurva
Calochortus albus
Calochortus Maweanus var. *major*
Calochortus lilacinus
Calochortus nitidus
Calochortus Howellii
Calochortus Leichtlinii
Calochortus luteus var. *oculatus*
Calochortus splendens
Tulipa Hageri

Tulipa sylvestris
Tulipa Greigi
Tulipa Billietiana
Tulipa Didieri
Tulipa Didieri var. *mauriana*
Tulipa Didieri var. *Fransoniana*
Tulipa Clusiana
Tulipa Clusiana var. *persica*
Tulipa oculus-solis
Tulipa praecox
Tulipa australis
Scilla sibirica
Puschkinia scilloides
Puschkinia scilloides var. *libanotica*
Ornithogalum nutans
Ornithogalum umbellatum
Ornithogalum narbonense (pyrami-
dale)
Erythronium Dens-canis
Erythronium Dens-canis var. *grand.*
Erythronium americanum
Erythronium grandiflorum
Erythronium citrinum
Erythronium californicum
Galtonia candicans
Convallaria majalis
Trillium grandiflorum
Trillium ovatum
Trillium sessile var. *californicum*
Alstroemeria ligtu
Alstroemeria brasiliensis
Iris florentina
Iris Bismarckiana
Iris xiphium var. *Grand Tresorier*
Tigridia Pavonia var. *grand. alba*
Tigridia Pavonia var. *conchiflora*
Crocus Susianus (Cloth of Gold)
Sparaxis var. (Albertine)
Musa ensete
Nymphaea marliacea var. *carnea*
Nelumbo lutea
Anemone apennina
Anemone fulgens
Anemone blanda
Anemone japonica
Aconitum Napellus
Actaea alba
Actaea spicata var. *rubra*
Cimicifuga racemosa
Eranthis hyemalis
Ranunculus bulbosus

Ranunculus Ficaria
Adonis amurensis
Cochlearia Armoracia
Jatropha Curcas
Cyclamen repandum
Cyclamen coum
Gloxinia var.

1-2, one to two minutes for gelatinization

Zea Mays var. *evarta* (Golden Queen)
Zea Mays var. *evarta* (White Rice)
Zea Mays var. *saccharata* (G. B'm)
Panicum Crus-galli var.
Triticum sativum var. *dicoccum*
Secale cereale var. (Spring)
Vicia Gerardi
Lathyrus sylvestris
Arachis hypogaea
Quercus Prinus
Dieffenbachia seg. var. *irror.* (cort.)
Lilium auratum
Calochortus Benthani
Scilla peruviana
Scilla bifolia
Chionodoxa Lucillae
Chionodoxa Tmolusi
Chionodoxa sardensis
Ornithogalum thyrsoides var. *aureum*
Hyacinthus orientalis var. *albus* *superb.*
Muscari micranthum
Muscari commutatum
Brodiaea laxa
Colchicum Parkinsoni
Galanthus nivalis
Alstroemeria aurantiaca (aurea)
Iris pallida speciosa
Iris iberica
Iris xiphium var. *Wilhelmine*
Iris xiphium var. *lusitanica*
Iris reticulata
Iris caucasica
Antholyza paniculata
Crocus var. (Baron von Brunow)
Sparaxis grandiflora alba
Ixia speciosa
Ixia viridiflora
Ixia var. (Emma)
Babiana var. (violacea)
Babiana var. (Attraction)
Musa sapientum
Zingiber officinale
Canna Warscewiczii
Canna var. (Königin Charlotte)
Canna var. (President Carnot)
Canna var. (L. E. Bailly)
Canna var. (Mrs. Kate Grey)
Canna var. (J. D. Eisele)
Maranta arundinacea var. No. 1
Maranta arundinacea var. No. 2
Maranta leuconeura

Nymphaea alba
Nymphaea odorata var. *rosea*
Nelumbo nucifera
Manihot utilisima
Trianosperma ficifolia
Dioon edule

2-3, two to three minutes for gelatinization

Zea Mays var. *saccharata* (S.'s E'n)
Andropogon Sorghum var. (W. K. Corn)
Andropogon Sorghum var. (Shallu)
Triticum sativum var. *vulgare*
Secale cereale var. (Mammoth Winter)
Hordeum sativum var. (Champion)
Vicia villosa
Vicia Faba
Vicia fulgens
Pisum sativum var. (Eugenie, green)
Hyacinthus orientalis var. *albulus* (White)
Hyacinthus orientalis var. *albulus* (Italian)
Muscari racemosum
Muscari compactum
Muscari comosum
Amarylly belladonna major
Hymenocallis calathina
Iris pumila var. *cyanea*
Iris tingitana
Iris alata
Watsonia iridifolia var. O'Brieni
Freesia refracta var. *Leichtlinii*
Antholyza crocosmoides
Crocus versicolor (Cloth of Silver)
Cypella Herberti
Musa Cavendishii (green fruit)
Canna Roscoeana
Canna edulis
Canna var. (Jean Tissot)
Maranta Massangeana
Nymphaea Gladstoniana
Nymphaea odorata

3-4, three to four minutes for gelatinization

Zea Mays var. *indurata* (N. Dakota)
Zea Mays var. *indurata* (C.'s Early)
Andropogon Sorghum var. (Y. B. Sorgh.)
Oryza sativa var.
Lathyrus latifolius var. *albus*
Pisum sativum var. (Mam. G. Seeded)
Richardia africana
Dieffenbachia seg. var. *nob.* (pith)
Dieffenbachia seg. var. *nob.* (cort.)
Dieffenbachia seg. *irror.* (pith)
Dieffenbachia illustris (pith)
Dieffenbachia illustris (cortex)

Muscari botryoides
Muscari paradoxum
Muscari conicum
Brodiaea candida
Brodiaea lactea
Triteleia uniflora
Leucojum vernal
Narcissus Jonquilla var. *rugulosus*
Tacca pinnatifida
Iris Histrio
Moraea tristis
Gladiolus cardinalis (Blushing Bride)
Gladiolus floribundus
Tritonia Pottsii
Tritonia crocosmaeflora
Freesia refracta var. *alba*
Romulea rosea var. *speciosa*
Canna musaeifolia
Maranta arundinacea
Nymphaea marliacea var. *albida*
Cycas circinalis

4-5, four to five minutes for gelatinization

Vicia sativa
Lathyrus magellanicus var. *albus*
Pisum sativum var. (Thos. Laxton)
Pisum sativum var. (L. W. Marrow-fat)
Arum italicum
Arisaema triphyllum
Richardia Elliotiana
Dieffenbachia seg. var. *mac.* (cort.)
Brodiaea congesta
Lachenalia pendula
Vallota purpurea
Hymenocallis undulata
Leucojum aestivum
Narcissus maximus
Narcissus Bulbocodium var. *monophyllus*
Narcissus odoratus
Narcissus biflorus
Gladiolus primulinus
Watsonia humilis
Watsonia Meriana
Musa Cavendishii
Hedychium Gardnerianum
Calathea vittata
Calathea Vandenheckei
Stromanthe sanguinea
Gesneria tubiflora
Cycas revoluta

5-6, five to six minutes for gelatinization

Pisum sativum var. (Eugenie, yellow)
Pisum sativum var. (Elec. E. Early)
Arum cornutum
Dieffenbachia seg. var. *mac.* (pith)
Brodiaea ixioides var. *splendens*
Brodiaea coccinea
Hippeastrum vittatum

Hippeastrum equestre
Hippeastrum aulicum var. *robustum*
Zephyranthes candida
Zephyranthes rosea
Narcissus Bulbocodium var. *conspicuus*
Narcissus incomparabilis
Marica gracilis
Calathea Lietzei
Calathea Wiotiana
Solanum tuberosum
Zamia integrifolia

6-7, six to seven minutes for gelatinization

Dolichos Lablab
Mucuna pruriens
Dracunculus vulgaris
Haemanthus Katherinae
Sternbergia lutea
Narcissus Jonquilla var. *Campbellii*
rug.
Gladiolus byzantinus
Batalas edulis

7-8, seven to eight minutes for gelatinization

Phaseolus vulgaris var. (Red K. Bean)
Phaseolus lunatus var. (H.'s B. Lima)
Galanthus Elwesii
Narcissus Bulbocodium
Narcissus tazetta var. *orientalis*
Maranta musaica

8-9, eight to nine minutes for gelatinization

Narcissus poeticus
Curcuma petiolata

9-10, nine to ten minutes for gelatinization

Lathyrus odoratus var. *Shahzada*
Arum palaestinum
Richardia albo-maculata
Brodiaea peduncularis
Brodiaea grandiflora
Brodiaea Purdyi
Brodiaea stellaris
Brodiaea capitata
Crinum americanum
Sprekelia formosissima
Narcissus Jonquilla
Curcuma longa

10-11, ten to eleven minutes for gelatinization

Zingiber officinale var. *Cochin*
Hedychium coronarium

11-12, eleven to twelve minutes for gelatinization	13-, thirteen or more minutes for gelatinization
Gelasine azurea	Crinum fimbriatulum
	Narcissus Horsfieldii
	Homeria collina
12-13, twelve to thirteen minutes for gelatinization	Tritonia crocata
Lens esculenta	Tritonia crocata var. lilacina
Zingiber officinale var. Jamaica, No. 2	Tritonia crocata var. rosea
	Tritonia securigera
	Zingiber officinale var. Jamaica, No. 1

THE PYROGALLIC ACID REACTIONS OF VARIOUS STARCHES

TABLE H

0-5, zero to five minutes for gelatinization	Polygonum Fagopyrum var. (Japanese)
Zea Mays var. everta (Golden Queen)	Quercus alba
Zea Mays var. everta (White Rice)	Quercus Prinus
Zea Mays var. indurata (N. Dakota)	Quercus rubra
Zea Mays var. indurata (C.'s Early)	Quercus texana
Zea Mays var. indentata (E'y L'g)	Castanea americana
Zea Mays var. indentata (H. King)	Castanea sativa var. numbo
Zea Mays var. saccharata (S.'s E'n)	Castanea sativa var.
Zea Mays var. saccharata (B. Mex.)	Castanea pumila
Zea Mays var. saccharata (G. B'm)	Aesculus Hippocastanum
Andropogon Sorghum var. (W. K. Corn)	Dieffenbachia seg. var. nob. (pith)
Andropogon Sorghum var. (Y. B. Sorgh.)	Dieffenbachia seg. var. nob. (cort.)
Andropogon Sorghum var. (Shallu)	Lilium candidum
Triticum sativum var. vulgare	Lilium longiflorum var. giganteum
Triticum sativum var. dicoccum	Lilium longiflorum var. eximium
Secale cereale var. (Mammoth Winter)	Lilium Parryi
Secale cereale var. (Spring)	Lilium rubellum
Hordeum sativum var. (Champion)	Lilium philadelphicum
Avena sativa var. (Clydesdale)	Lilium tigrinum var. splendens
Arrhenatherum elatius var.	Lilium Henryi
Vicia sativa	Lilium auratum
Vicia villosa	Lilium speciosum var. album
Vicia fulgens	Lilium martagon
Vicia Gerardi	Lilium superbum
Phaseolus vulgaris var. (Red K. Bean)	Lilium tenuifolium
Phaseolus lunatus var. (H.'s B. Lima)	Lilium pardalinum
Lens esculenta	Lilium puberulum
Lathyrus odoratus var. Shahzada	Fritillaria meleagris
Lathyrus sylvestris	Fritillaria pyrenaica
Lathyrus latifolius var. albus	Fritillaria pudica
Lathyrus magellanicus var. albus	Fritillaria aurea
Pisum sativum var. (Elec. E. Early)	Fritillaria armena
Pisum sativum var. (Mam. G. Seeded)	Fritillaria imperialis var. Aurora
Pisum sativum var. (L. W. Marrow-fat)	Fritillaria liliacea
Arachis hypogaea	Fritillaria recurva
Polygonum Fagopyrum var. (American)	Calochortus albus
	Calochortus Benthami
	Calochortus lilacinus
	Calochortus nitidus
	Calochortus Howellii
	Calochortus splendens
	Tulipa Hageri
	Tulipa sylvestris
	Tulipa Greigi

- Tulipa* Billietiana
Tulipa Didieri
Tulipa Didieri var. *mauriana*
Tulipa Didieri var. *Fransoniana*
Tulipa Clusiana
Tulipa Clusiana var. *persica*
Tulipa oculus-solis
Tulipa praecox
Tulipa australis
Scilla sibirica
Scilla peruviana
Scilla bifolia
Chionodoxa Lucillae
Chionodoxa Tmolusi
Chionodoxa sardensis
Puschkinia scilloides
Puschkinia scilloides var. *libanotica*
Ornithogalum umbellatum
Ornithogalum narbonense (pyrami-
 dale)
Ornithogalum thyrsoides var. *aureum*
Erythronium Dens-canis
Erythronium Dens-canis var. *grand.*
Erythronium americanum
Erythronium grandiflorum
Erythronium citrinum
Erythronium californicum
Hyacinthus orientalis var. *albus*
 superb.
Hyacinthus orientalis var. *albulus*
 (White)
Hyacinthus orientalis var. *albulus*
 (Italian)
Galtonia candicans
Muscari botryoides
Muscari compactum
Brodiaea ixioides var. *splendens*
Brodiaea candida
Brodiaea lactea
Brodiaea laxa
Triteleia uniflora
Lachenalia pendula
Lachenalia tricolor var. *luteola*
Convallaria majalis
Trillium grandiflorum
Trillium ovatum
Trillium sessile var. *californicum*
Colchicum Parkinsoni
Amaryllis belladonna major
Crinum fimbriatulum
Crinum americanum
Sprekelia formosissima
Haemanthus Katherinae
Hymenocallis undulata
Hymenocallis calathina
Leucojum vernum
Leucojum aestivum
Alstroemeria ligtu
Alstroemeria brasiliensis
Alstroemeria aurantiaca (aurea)
Tacca pinnatifida
Iris florentina
Iris pallida speciosa
Iris pumila var. *cyanea*
Iris Bismarckiana
Iris iberica
Iris xiphium var. *Grand Tresorier*
Iris xiphium var. *Wilhelmine*
Iris xiphium var. *lusitanica*
Iris tingitana
Iris reticulata
Iris Histrio
Iris alata
Iris caucasica
Tigridia Pavonia var. *grand. alba*
Tigridia Pavonia var. *conchiflora*
Antholyza crocosmoides
Antholyza paniculata
Crocus Susianus (Cloth of Gold)
Crocus versicolor (Cloth of Silver)
Crocus var. (Baron von Brunow)
Cypella Herberti
Marica gracilis
Sparaxis grandiflora alba
Sparaxis var. (Albertine)
Maranta arundinacea
Maranta arundinacea var. *No. 1*
Maranta arundinacea var. *No. 2*
Maranta Massangeana
Maranta leuconeura
Maranta musaica
Nymphaea alba
Nymphaea marliacea var. *carnea*
Nymphaea odorata
Nymphaea odorata var. *rosea*
Nelumbo nucifera
Nelumbo lutea
Anemone apennina
Anemone fulgens
Anemone blanda
Anemone japonica
Aconitum Napellus
Actaea alba
Actaea spicata var. *rubra*
Cimicifuga racemosa
Eranthis hyemalis
Ranunculus bulbosus
Ranunculus Ficaria
Adonis amurensis
Cochlearia Armoracia
Jatropha Curcas
Manihot utilisissima
Cyclamen repandum
Cyclamen coum
Gloxinia var.
Trianosperma ficifolia
Dioon edule
 5-10, five to ten minutes for gelatini-
 zation
Panicum Crus-galli var.
Oryza sativa var.
Vicia Faba
Wistaria chinensis
Arum italicum

- Dieffenbachia seg. var. mac. (pith)
 Dieffenbachia seg. var. mac. (cort.)
 Dieffenbachia seg. var. irror. (pith)
 Dieffenbachia seg. var. irror. (cort.)
 Dieffenbachia illustris (pith)
 Calochortus Maweanus var. major
 Calochortus Leichtlinii
 Calochortus luteus var. oculatus
 Ornithogalum nutans
 Muscari micranthum
 Muscari comosum
 Brodiaea peduncularis
 Watsonia iridifolia var. O'Brieni
 Ixia speciosa
 Babiana var. (Attraction)
 Stromanthe sanguinea
 Nymphaea mariacea var. albidia
 Nymphaea Gladstoniana
 Zamia integrifolia
- 10-15, ten to fifteen minutes for gelatinization
 Mucuna pruriens
 Arum palaestinum
 Dracunculus vulgaris
 Dieffenbachia illustris (cortex)
 Galanthus nivalis
 Narcissus Bulbocodium var. monophyllus
 Narcissus Jonquilla var. rugulosus
 Gladiolus floribundus
 Watsonia humilis
 Watsonia Meriana
 Tritonia Pottii
 Tritonia crocosmaeflora
 Musa ensete
 Canna var. (President Carnot)
 Canna var. (Jean Tissot)
 Canna var. (J. D. Eisele)
- 15-20, fifteen to twenty minutes for gelatinization
 Dolichos Lablab
 Muscari paradoxum
 Hippeastrum aulicum var. robustum
 Narcissus Bulbocodium var. conspicuus
 Ixia viridiflora
 Ixia var. (Emma)
 Babiana var. (violacea)
 Canna edulis
 Canna var. (Mrs. Kate Grey)
 Calathea vittata
- 20-25, twenty to twenty-five minutes for gelatinization
 Arisaema triphyllum
 Muscari commutatum
 Vallota purpurea
 Sternbergia lutea
 Narcissus biflorus
 Gladiolus cardinalis (Blushing Bride)
- Zingiber officinale var. Cochin
 Solanum tuberosum
 Cycas circinalis
- 25-30, twenty-five to thirty minutes for gelatinization
 Arum cornutum
 Muscari racemosum
 Hippeastrum vittatum
 Zephyranthes rosea
 Narcissus incomparabilis
 Gladiolus byzantinus
 Curcuma longa
 Canna var. (L. E. Baily)
 Gesneria tubiflora
 Cycas revoluta
- 30-35, thirty to thirty-five minutes for gelatinization
 Muscari conicum
 Hippeastrum equestre
 Zephyranthes candida
 Narcissus maximus
 Gladiolus primulinus
- 35-40, thirty-five to forty minutes for gelatinization
 Brodiaea stellaris
 Canna var. (Königin Charlotte)
- 40-45, forty to forty-five minutes for gelatinization
 Brodiaea californica
 Galanthus Elwesii
 Narcissus Bulbocodium
 Musa Cavendishii
 Musa Cavendishii (green fruit)
 Musa sapientum
 Batatas edulis
- 45-50, forty-five to fifty minutes for gelatinization
 None
- 50-55, fifty to fifty-five minutes for gelatinization
 None
- 55-60, fifty-five to sixty minutes for gelatinization
 Pisum sativum var. (Eugenie, yellow)
 Pisum sativum var. (Eugenie, green)
 Pisum sativum var. (Thos. Laxton)
 Richardia Elliotiana
 Richardia africana
 Richardia albo-maculata
 Brodiaea coccinea
 Brodiaea grandiflora
 Brodiaea Purdyi
 Brodiaea capitata

Brodiaea congesta
Narcissus Horsfieldii
Narcissus odorus
Narcissus poeticus
Narcissus Jonquilla
Narcissus Jonquilla var. *Campernellii*
 rug.
Narcissus tazetta var. *orientalis*
Moraea tristis
Homeria collina
Tritonia crocata
Tritonia crocata var. *lilacina*
Tritonia crocata var. *rosea*
Tritonia securigera
Freesia refracta var. *alba*

Freesia refracta var. *Leichtlinii*
Romulea rosea var. *speciosa*
Gelasine azurea
Zingiber officinale
Zingiber officinale var. *Jamaica* No. 1
Zingiber officinale var. *Jamaica* No. 2
Hedychium coronarium
Hedychium Gardnerianum
Curcuma petiolata
Canna Warscewiczii
Canna Roscoeana
Canna musaeifolia
Calathea Lietzei
Calathea Wiotiana
Calathea Vandenheckei

THE FERRIC CHLORIDE REACTION OF VARIOUS STARCHES

TABLE I

0-5, zero to five minutes for gelatinization

Castanea americana
Castanea sativa var. *numbo*
Castanea sativa var.
Castanea pumila
Aesculus Hippocastanum
Calochortus Benthami
Calochortus lilacinus
Calochortus nitidus
Calochortus Howellii
Tulipa Hageri
Tulipa Clusiana
Tulipa australis
Erythronium Dens-canis
Erythronium Dens-canis var. *grand.*
Erythronium americanum
Erythronium grandiflorum
Erythronium citrinum
Erythronium californicum
Galtonia candicans
Convallaria majalis
Trillium grandiflorum
Trillium ovatum
Iris Bismarckiana
Sparaxis grandiflora *alba*
Sparaxis var. (*Albertine*)
Musa Cavendishii (green fruit)
Zingiber officinale
Hedychium Gardnerianum
Maranta arundinacea
Anemone apennina
Anemone fulgens
Anemone blanda
Anemone japonica
Aconitum Napellus
Actaea alba
Cimicifuga racemosa
Ranunculus bulbosus

Ranunculus Ficaria
Adonis amurensis
Cochlearia Armoracia
Cyclamen repandum
Cyclamen coum
Batatas edulis
Trianosperma ficifolia

5-10, five to ten minutes for gelatinization

Zea Mays var. *evarta* (Golden Queen)
Zea Mays var. *evarta* (White Rice)
Zea Mays var. *indentata* (H. King)
Zea Mays var. *saccharata* (S.'s E'n)
Zea Mays var. *saccharata* (G. B'm)
Oryza sativa var.
Avena sativa var. (*Clydesdale*)
Arrhenatherum elatius var.
Arum italicum
Dieffenbachia seg. var. *nob.* (cort.)
Lilium longiflorum var. *eximium*
Lilium tigrinum var. *splendens*
Lilium auratum
Lilium superbum
Fritillaria pyrenaica
Fritillaria aurea
Fritillaria armena
Calochortus albus
Calochortus Maweanus var. *major*
Calochortus Leichtlinii
Calochortus luteus var. *oculatus*
Calochortus splendens
Tulipa sylvestris
Tulipa Greigi
Tulipa Billietiana
Tulipa Didieri
Tulipa Didieri var. *mauriana*
Tulipa oculus-solis
Tulipa praecox

Chionodoxa Tmolusi
Chionodoxa sardensis
Ornithogalum narbonne (pyrami-
dale)
Hyacinthus orientalis var. albus
superb.
Hyacinthus orientalis var. albulus
(White)
Trillium sessile var. californicum
Iris florentina
Iris xiphium var. Wilhelmine
Crocus Susianus (Cloth of Gold)
Ixia speciosa
Musa Cavendishii
Musa sapientum
Musa ensete
Hedychium coronarium
Curcuma longa
Curcuma petiolata
Canna Roscoeana
Maranta arundinacea var. No. 1
Maranta leuconeura
Nelumbo lutea
Actaea spicata var. rubra
Eranthus hyemalis
Gesneria tubiflora
Gloxinia var.
Dioon edule

10-15, ten to fifteen minutes for
gelatinization

Zea Mays var. indurata (N. Dakota)
Zea Mays var. indurata (C.'s Early)
Zea Mays var. indentata (E'y L'g)
Andropogon Sorghum var. (Y. B.
Sorgh.)
Andropogon Sorghum var. (Shallu)
Arachis hypogaea
Quercus rubra
Quercus texana
Arum cornutum
Dieffenbachia seg. var. irror. (pith)
Lilium Parryi
Lilium philadelphicum
Lilium martagon
Fritillaria meleagris
Fritillaria imperialis var. Aurora
Fritillaria liliacea
Fritillaria recurva
Tulipa Didieri var. Fransoniana
Tulipa Clusiana var. persica
Scilla sibirica
Ornithogalum nutans
Ornithogalum umbellatum
Ornithogalum thyrsoides var. aureum
Hyacinthus orient. var. albulus
(Italian)
Muscari micranthum
Alstroemeria ligtu
Alstroemeria brasiliensis
Iris pallida speciosa
Iris pumila var. cyanea

Iris iberica
Iris xiphium var. Grand Tresorier
Iris xiphium var. lusitanica
Tigridia Pavonia var. grand. alba
Tigridia Pavonia var. conchiflora
Crocus versicolor (Cloth of Silver)
Crocus var. (Baron von Brunow)
Ixia iridiflora
Babiana var. (violacea)
Canna Warscewiczii
Canna var. (President Carnot)
Maranta arundinacea var. No. 2
Maranta Massangeana
Calathea Lietzei
Nymphaea alba
Nelumbo nucifera

15-20, fifteen to twenty minutes for
gelatinization

Andropogon Sorghum var. (W. K.
Corn)
Wistaria chinensis
Polygonum Fagopyrum var.
(Japanese)
Dieffenbachia seg. var. nob. (pith)
Dieffenbachia illustris (cortex)
Lilium longiflorum var. giganteum
Lilium rubellum
Lilium speciosum var. album
Lilium tenuifolium
Lilium pardalinum
Lilium puberulum
Fritillaria pudica
Scilla peruviana
Scilla bifolia
Puschkinia scilloides
Puschkinia scilloides var. libanotica
Lachenalia pendula
Lachenalia tricolor var. luteola
Amaryllis belladonna major
Alstroemeria aurantiaca (aurea)
Iris tingitana
Ixia var. (Emma)
Babiana var. (Attraction)
Canna var. 'Königin Charlotte'
Canna var. 'Mrs. Kate Grey'
Canna var. 'J. D. Eisele'
Nymphaea odorata
Jatropha Curcas
Manihot utilisima

20-25, twenty to twenty-five minutes
for gelatinization

Panicum Crus-galli var.
Dieffenbachia seg. var. mac. (pith)
Dieffenbachia seg. var. mac. (cort.)
Lilium candidum
Muscari racemosum
Brodiaea coccinea
Sprekelia formosissima
Gladiolus primulinus
Gladiolus floribundus

Antholyza paniculata
Canna musaefolia
Canna var. (L. E. Baily)
Canna var. (Jean Tissot)
Nymphaea marliacea var. *carnea*
Solanum tuberosum
Cycas revoluta
Cycas circinalis

25-30, twenty-five to thirty minutes
 for gelatinization

Pisum sativum var. (Eugenie, yellow)
Pisum sativum var. (Eugenie, green)
Pisum sativum var. (Thos. Laxton)
Quercus alba
Quercus Prinus
Arum palaestinum
Arisaema triphyllum
Dieffenbachia seg. var. *mac.* (cort.)
Dieffenbachia illustris (pith)
Lilium Henryi
Chionodoxa Lucillae
Brodiaea candida
Colchicum Parkinsoni
Crinum americanum
Hymenocallis calathina
Iris alata
Freesia refracta var. *alba*
Freesia refracta var. *Leichtlinii*
Cypella Herberti

30-35, thirty to thirty-five minutes for
 gelatinization

Polygonum Fagopyrum var. (American)
Richardia Elliotiana
Muscari commutatum
Muscari compactum
Muscari comosum
Tacca pinnatifida
Iris reticulata
Tritonia securigera
Stromanthe sanguinea
Nymphaea odorata var. *rosea*

35-40, thirty-five to forty minutes for
 gelatinization

Vicia villosa
Richardia africana
Muscari botryoides
Brodiaea lactea
Hippeastrum aulicum var. *robustum*
Zephyranthes candida
Narcissus Jonquilla
Narcissus Jonquilla var. *rugulosus*
Iris caucasica
Watsonia humilis
Tritonia crocata
Tritonia Pottsi
Antholyza crocosmoides

40-45, forty to forty-five minutes for
 gelatinization

Vicia Gerardi
Quercus Muhlenbergii
Dracunculus vulgaris
Muscari paradoxum
Brodiaea laxa
Narcissus Bulbocodium
Narcissus Bulbocodium var. *monophyllus*
Narcissus incomparabilis
Narcissus Jonquilla var. *Campernellii*
rug.
Moraea tristis
Gladiolus byzantinus
Gladiolus cardinalis (Blushing Bride)
Watsonia iridifolia var. *O'Brieni*
Watsonia Meriana
Tritonia crocata var. *rosea*
Tritonia crocosmaeflora
Marica gracilis
Zingiber officinale var. *Jamaica No. 2*
Canna edulis
Nymphaea Gladstoniana

45-50, forty-five to fifty minutes for
 gelatinization

Brodiaea ixioidea var. *splendens*
Hippeastrum equestre
Zephyranthes rosea
Haemanthus Katherinae
Narcissus odoratus
Iris Histrio
Nymphaea marliacea var. *albida*

50-55, fifty to fifty-five minutes for
 gelatinization

Triteleia uniflora
Hippeastrum vittatum
Vallota purpurea
Zingiber officinale var. *Cochin*

55-60, fifty-five to sixty minutes for
 gelatinization

Triticum sativum var. *vulgare*
Triticum sativum var. *dicoccum*
Secale cereale var. (Mammoth Winter)
Secale cereale var. (Spring)
Hordeum sativum var. (Champion)
Vicia sativa
Vicia Faba
Vicia fulgens
Phaseolus vulgaris var. (Red K. Bean)
Phaseolus lunatus var. (H.'s B. Lima)
Dolichos Lablab
Mucuna pruriens
Lens esculenta
Lathyrus odoratus var. *Shahzada*
Lathyrus sylvestris
Lathyrus latifolius var. *albus*

<i>Lathyrus magellanicus</i> var. <i>albus</i>	<i>Sternbergia lutea</i>
<i>Pisum sativum</i> var. (Elec. E. Early)	<i>Narcissus Horsfieldii</i>
<i>Pisum sativum</i> var. (Mam. G. Seeded)	<i>Narcissus maximus</i>
<i>Pisum sativum</i> var. (L. W. Marrow-fat)	<i>Narcissus Bulbocodium</i> var. <i>conspicuus</i>
<i>Richardia albo-maculata</i>	<i>Narcissus poeticus</i>
<i>Muscari conicum</i>	<i>Narcissus biflorus</i>
<i>Brodiaea peduncularis</i>	<i>Narcissus tazetta</i> var. <i>orientalis</i>
<i>Brodiaea grandiflora</i>	<i>Homeria collina</i>
<i>Brodiaea californica</i>	<i>Tritonia crocata</i> var. <i>lilacina</i>
<i>Brodiaea Purdyi</i>	<i>Romulea rosea</i> var. <i>speciosa</i>
<i>Brodiaea stellaris</i>	<i>Gelasine azurea</i>
<i>Brodiaea capitata</i>	<i>Zingiber officinale</i> var. <i>Jamaica</i> , No. 1
<i>Brodiaea congesta</i>	<i>Maranta musaica</i>
<i>Crinum fimbriatulum</i>	<i>Calathea vittata</i>
<i>Hymenocallis undulata</i>	<i>Calathea Wiotiana</i>
<i>Leucojum vernum</i>	<i>Calathea Vandenheckei</i>
<i>Leucojum aestivum</i>	<i>Zamia integrifolia</i>
<i>Galanthus nivalis</i>	

THE PURDY'S SOLUTION REACTIONS OF VARIOUS STARCHES

TABLE J

0-5, zero to five minutes for gelatinization

<i>Quercus alba</i>	<i>Calochortus luteus</i> var. <i>oculatus</i>
<i>Castanea americana</i>	<i>Calochortus splendens</i>
<i>Castanea sativa</i> var. <i>numbo</i>	<i>Tulipa Hageri</i>
<i>Castanea sativa</i> var.	<i>Tulipa sylvestris</i>
<i>Castanea pumila</i>	<i>Tulipa Greigi</i>
<i>Lilium candidum</i>	<i>Tulipa Billietiana</i>
<i>Lilium longiflorum</i> var. <i>giganteum</i>	<i>Tulipa Didieri</i>
<i>Lilium longiflorum</i> var. <i>eximium</i>	<i>Tulipa Didieri</i> var. <i>mauriana</i>
<i>Lilium Parryi</i>	<i>Tulipa Didieri</i> var. <i>Fransoniana</i>
<i>Lilium rubellum</i>	<i>Tulipa Clusiana</i>
<i>Lilium philadelphicum</i>	<i>Tulipa Clusiana</i> var. <i>persica</i>
<i>Lilium tigrinum</i> var. <i>splendens</i>	<i>Tulipa oculus-solis</i>
<i>Lilium Henryi</i>	<i>Tulipa praecox</i>
<i>Lilium auratum</i>	<i>Tulipa australis</i>
<i>Lilium speciosum</i> var. <i>album</i>	<i>Scilla peruviana</i>
<i>Lilium martagon</i>	<i>Scilla bifolia</i>
<i>Lilium superbum</i>	<i>Chionodoxa Lucillae</i>
<i>Lilium tenuifolium</i>	<i>Chionodoxa sardensis</i>
<i>Lilium pardalinum</i>	<i>Ornithogalum nutans</i>
<i>Lilium puberulum</i>	<i>Ornithogalum umbellatum</i>
<i>Fritillaria meleagris</i>	<i>Ornithogalum narbonense</i> (pyramidal)
<i>Fritillaria pyrenaica</i>	<i>Erythronium Dens-canis</i>
<i>Fritillaria pudica</i>	<i>Erythronium Dens-canis</i> var. <i>grand.</i>
<i>Fritillaria aurea</i>	<i>Erythronium americanum</i>
<i>Fritillaria armena</i>	<i>Erythronium grandiflorum</i>
<i>Fritillaria liliacea</i>	<i>Erythronium citrinum</i>
<i>Fritillaria recurva</i>	<i>Erythronium californicum</i>
<i>Calochortus albus</i>	<i>Galtonia candicans</i>
<i>Calochortus Maweanus</i> var. <i>major</i>	<i>Convallaria majalis</i>
<i>Calochortus Benthani</i>	<i>Alstroemeria ligtu</i>
<i>Calochortus lilacinus</i>	<i>Alstroemeria brasiliensis</i>
<i>Calochortus nitidus</i>	<i>Alstroemeria aurantiaca</i> (aurea)
<i>Calochortus Howellii</i>	<i>Iris Histrio</i>
<i>Calochortus Leichtlinii</i>	<i>Sparaxis grandiflora alba</i>

Sparaxis var. (Albertine)
 Zingiber officinale
 Curcuma longa
 Curcuma petiolata
 Maranta arundinacea
 Maranta arundinacea var. No. 1
 Maranta arundinacea var. No. 2
 Maranta leuconeura
 Nelumbo lutea
 Anemone apennina
 Anemone fulgens
 Anemone blanda
 Anemone japonica
 Aconitum Napellus
 Actaea alba
 Actaea spicata var. rubra
 Cimicifuga racemosa
 Eranthis hyemalis
 Adonis amurensis
 Cochlearia Armoracia
 Gloxinia var.
 Trianosperma ficifolia
 Dioon edule

5-10, five to ten minutes for gelatinization

Fritillaria imperialis var. Aurora
 Chionodoxa Tmolusi
 Ornithogalum thyrsoides var. aureum
 Trillium grandiflorum
 Iris caucasica
 Ixia speciosa
 Babiana var. (Attraction)
 Musa Cavendishii (green fruit)
 Musa sapientum
 Musa ensete
 Zingiber officinale var. Jamaica, No. 1
 Zingiber officinale var. Jamaica, No. 2
 Zingiber officinale var. Cochinchina
 Canna var. (President Carnot)
 Maranta Massangeana
 Maranta musacea
 Calathea vittata
 Calathea Wiotiana
 Ranunculus bulbosus
 Jatropha Curcas
 Cyclamen repandum

10-15, ten to fifteen minutes for gelatinization

Triticum sativum var. dicoccum
 Vicia Faba
 Scilla sibirica
 Puschkinia scilloides
 Trillium ovatum
 Amaryllis belladonna major
 Iris reticulata
 Iris alata
 Ixia viridiflora
 Musa Cavendishii
 Canna Roscoeana
 Canna var. (Königin Charlotte)

Canna var. (Mrs. Kate Grey)
 Canna var. (J. D. Eisele)
 Nymphaea alba
 Nymphaea odorata var. rosea
 Cyclamen coum
 Solanum tuberosum
 Gesneria tubiflora

15-20, fifteen to twenty minutes for gelatinization

Vicia villosa
 Arachis hypogaea
 Aesculus Hippocastanum
 Puschkinia scilloides var. libanotica
 Tigridia Pavonia var. conchiflora
 Ixia var. (Emma)
 Babiana var. (violacea)
 Canna musaeifolia
 Canna edulis
 Canna var. (Jean Tissot)
 Calathea Lietzei
 Stromanthe sanguinea
 Nelumbo nucifera

20-25, twenty to twenty-five minutes for gelatinization

Triticum sativum var. vulgare
 Vicia Gerardi
 Trillium sessile var. californicum
 Tigridia Pavonia var. grand. alba
 Canna Warscewiczii
 Canna var. (L. E. Baily)
 Nymphaea marliacea var. carnea
 Nymphaea odorata
 Manihot utilisima

25-30, twenty-five to thirty minutes for gelatinization

Lathyrus sylvestris
 Lathyrus latifolius var. albus
 Pisum sativum var. (Eugenie, yellow)
 Pisum sativum var. (Eugenie, green)
 Pisum sativum var. (Thos. Laxton)
 Quercus Prinus
 Hyacinthus orientalis var. albus
 superb.
 Crocus Susianus (Cloth of Gold)
 Ranunculus Ficaria

30-35, thirty to thirty-five minutes for gelatinization

None

35-40, thirty-five to forty minutes for gelatinization

Calathea Vandenheckei
 Cycas circinalis

40-45, forty to forty-five minutes for gelatinization

Hedychium coronarium
 Hedychium Gardnerianum

45-50, forty-five to fifty minutes for gelatinization

None

50-55, fifty to fifty-five minutes for gelatinization

None

55-60, fifty-five to sixty minutes for gelatinization

Zea Mays var. *evarta* (Golden Queen)

Zea Mays var. *evarta* (White Rice)

Zea Mays var. *indurata* (N. Dakota)

Zea Mays var. *indurata* (C.'s Early)

Zea Mays var. *indentata* (E'y L'g)

Zea Mays var. *saccharata* (S.'s E'n)

Zea Mays var. *saccharata* (B. Mex.)

Zea Mays var. *saccharata* (G. B'm)

Andropogon Sorghum var. (W. K. Corn)

Andropogon Sorghum var. (Y. B. Sorgh.)

Andropogon Sorghum var. (Shallu)

Panicum Crus-galli var.

Oryza sativa var.

Secale cereale var. (Mammoth Winter)

Secale cereale var. (Spring)

Hordeum sativum var. (Champion)

Avena sativa var. (Clydesdale)

Arrhenatherum elatius var.

Vicia sativa

Vicia fulgens

Phaseolus vulgaris var. (Red K. Bean)

Phaseolus lunatus var. (H.'s B. Lima)

Dolichos Lablab

Mucuna pruriens

Lens esculenta

Lathyrus odoratus var. *Shahzada*

Lathyrus magellanicus var. *albus*

Pisum sativum var. (Elec. E. Early)

Pisum sativum var. (Mam. G. Seeded)

Pisum sativum var. (L. W. Marrow-fat)

Wistaria chinensis

Polygonum Fagopyrum var. (American)

Polygonum Fagopyrum var. (Japanese)

Quercus Muhlenbergii

Quercus rubra

Quercus texana

Arum palaestinum

Arum cornutum

Arum italicum

Arisaema triphyllum

Dracunculus vulgaris

Richardia Elliotiana

Richardia africana

Richardia albo-maculata

Dieffenbachia seg. var. *nob.* (pith)

Dieffenbachia seg. var. *nob.* (cort.)

Dieffenbachia seg. var. *mac.* (pith)

Dieffenbachia seg. var. *mac.* (cort.)

Dieffenbachia seg. var. *irror.* (pith)

Dieffenbachia seg. var. *irror.* (cort.)

Dieffenbachia illustris (pith)

Dieffenbachia illustris (cortex)

Hyacinthus orientalis var. *albus* (White)

Hyacinthus orientalis var. *albulus* (Italian)

Muscari botryoides

Muscari paradoxum

Muscari micranthum

Muscari conicum

Muscari commutatum

Muscari racemosum

Muscari compactum

Muscari comosum

Brodiaea peduncularis

Brodiaea ixioides var. *splendens*

Brodiaea candida

Brodiaea lactea

Brodiaea laxa

Brodiaea coccinea

Brodiaea grandiflora

Brodiaea californica

Brodiaea Purdyi

Brodiaea stellaris

Brodiaea capitata

Brodiaea congesta

Triteleia uniflora

Lachenalia pendula

Lachenalia tricolor var. *luteola*

Colchicum Parkinsoni

Hippeastrum vittatum

Hippeastrum equestre

Hippeastrum aulicum var. *robustum*

Vallota purpurea

Crinum fimbriatulum

Crinum americanum

Zephyranthes candida

Zephyranthes rosea

Sprekelia formosissima

Haemanthus Katherineae

Hymenocallis undulata

Hymenocallis calathina

Leucojum vernalis

Leucojum aestivum

Galanthus nivalis

Galanthus Elwesii

Sternbergia lutea

Narcissus Horsfieldii

Narcissus maximus

Narcissus Bulbocodium

Narcissus Bulbocodium var. *conspicuus*

Narcissus Bulbocodium var. *monophyllus*

Narcissus incomparabilis

- | | |
|---------------------------------------|-------------------------------------|
| Narcissus odorus | Watsonia humilis |
| Narcissus poeticus | Watsonia iridifolia var. O'Brieni |
| Narcissus biflorus | Watsonia Meriana |
| Narcissus Jonquilla | Tritonia crocata |
| Narcissus Jonquilla var. rugulosus | Tritonia crocata var. lilacina |
| Narcissus Jonquilla var. Camper- | Tritonia securigera |
| nelli rug. | Tritonia Pottsii |
| Narcissus tazetta var. orientalis | Tritonia crocosmaeflora |
| Tacca pinnatifida | Freesia refracta var. alba |
| Iris florentina | Freesia refracta var. Leichtlinii |
| Iris pallida speciosa | Antholyza crocosmoides |
| Iris pumila var. cyanea | Antholyza paniculata |
| Iris Bismarckiana | Crocus versicolor (Cloth of Silver) |
| Iris iberica | Crocus var. (Baron von Brunow) |
| Iris xiphium var. Grand Tresorier | Romulea rosea var. speciosa |
| Iris xiphium var. Wilhelmine | Cypella Herberti |
| Iris xiphium var. lusitanica | Marica Herberti |
| Iris tingitana | Gelasine azurea |
| Moraea tristis | Nymphaea marliacea var. albida |
| Homeria collina | Nymphaea Gladstoniana |
| Gladiolus byzantinus | Batatas edulis |
| Gladiolus primulinus | Cycas revoluta |
| Gladiolus cardinalis (Blushing Bride) | Zamia integrifolia |
| Gladiolus floribundus | |

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A STUDY OF SOME CHARACTERISTICS
OF VEGETABLE OILS

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A STUDY OF SOME CHARACTERISTICS OF VEGETABLE OILS

JAMES B. MCNAIR

A number of years ago it occurred to the writer that there might be a relationship between the melting point of an oil of a plant and the temperature of its environment. The idea was suggested by the fact that in general the melting points of marine animal oils are lower than the melting points of the oils of land animals. In accordance with this idea tropical plants should have oils of higher melting points than those of plants of temperate climates; seeds may have oils of lower melting points than those contained in seed coverings; plants of tropical origin may retain their high melting-point oils in temperate climates; and oil properties may be of value in species identification.

In the tissues of most plants there are small particles of oil that may serve as reserve food for the plant or its seedlings. The most common storage place for oil is the seed, where oil is almost always present in at least a small amount, and in some cases it may be the dominant form of stored food. Oil is, however, not confined to seeds, but occurs also in the flesh of fruits (olives, oil palm fruits), in rootstocks and tubers (potato, iris, and sedges), and in bulbs (onion).

DATA AND DEFINITIONS USED

Data of approximately 318 oils, fats, and waxes have been assembled and reclassified for this article from Volume II of the sixth edition of Julius Lewkowitsch's *Chemical Technology and Analysis of Oils, Fats and Waxes*, published in 1922.

In the present article oils are classified in four groups: drying, semi-drying, non-drying, and fats. In order that the classification used may be better understood these four groups are defined as follows:

Drying oils are so called because they absorb oxygen from the air and dry to an elastic skin when exposed to the air in a thin layer. Linseed oil is a good example. The drying power is directly proportional to the size of the iodine value; consequently the best drying oils are those which absorb the greatest amount of iodine. The drying oils likewise have the lowest melting points of the oils here considered. Chemically they are glycerides of fatty acids

belonging to the linolenic and linolic groups, oleic acid forming only a small proportion of the liquid fatty acids.

Semi-drying oils have melting points and iodine values that lie between those of the drying oils and the non-drying oils. They differ chemically from drying oils by an almost complete absence of linolenic acid, while they are differentiated from non-drying oils by a larger content of linolic acid. The proportion of linolic acid decreases as the iodine value decreases. Cotton seed, maize, and sesame oils are examples of this group.

Non-drying oils have higher melting points and lower iodine values than those exhibited by the members of the drying and semi-drying oils. Linolenic acid is completely absent and linolic acid is present in small quantities only. Olive and castor oils are examples of this group.

Vegetable fats are oils that are solid in temperate climates. They present, however, a variety of gradations from the soft, buttery mass of laurel oil to the hard, waxlike Japan tallow. As the hardness of the fats increases approximately in direct proportion to the decrease of the content of glycerides of oleic and linolic acids, the iodine value would most appropriately determine, in the absence of other more striking chemical characteristics, the order in which the individual fats may be enumerated. Examples of fats are cacao butter, coconut oil, Japan wax, and myrtle wax.

Vegetable waxes as a group have higher melting points and lower iodine numbers than any of the oils here considered. They are not glycerides, but are chemical mixtures of fatty esters of higher monohydric aliphatic and phytosterol alcohols. Waxes are distinguished from fats by the fact that waxes are esters of monohydric alcohols while fats are esters of the trihydric alcohol, i.e., glycerol. Carnauba and palm waxes are examples.

Some 318 oils have been studied. Of these 318 oils, 62 are drying oils of low melting point, 83 are semi-drying oils of higher melting point, 71 are non-drying oils of still higher melting point, and 102 are fats.

OILS IN SEED KERNELS AND SEED COVERINGS

Oils are chiefly found accumulated in seeds. In fact, practically all the oils considered in this article come from this source. However, it may be well at this point to discuss the properties of the oils from seed kernels in contrast to the oils from seed coverings.

If it is true that the environment in which an oil is produced should influence its melting point, i.e., that oils produced in tropical plants should have higher melting points than those produced in cold climates, then it might be expected that oils found in seed coverings should have higher melting points than oils found in seed kernels of the same plant. It is understood that the diurnal fluctuations in air temperature to which the seed covering is subjected cause the daily maximum temperature of the seed covering to be greater than the daily maximum temperature of the seed kernel. In the tropics, where the minimum temperature is higher and the diurnal and seasonal fluctuations in temperature are less than in the temperate zone, the melting points of the seed covering

PHYSICAL AND CHEMICAL PROPERTIES OF OILS FROM KERNELS
AND SEED COVERINGS

Family	Plant	Oil Source	Sp. Gr. (15° C.)	Sapon. Value	Iodine Value	Class
Euphorbiaceae	<i>Sapium sebiferum</i>	covering,	.915 -.918	179.0-205.7	19.0 - 37.7	fat
		kernel	.9458	203.8-210.4	145.6 -160.7	drying
Anacardiaceae	<i>Rhus laurina</i>	covering	.9011	157.1	11.44	fat
	<i>Rhus succedanea</i>	covering	.975	217.5-237.5	4.2 - 15.1	fat
	<i>Rhus diversiloba</i>	covering	.9896	220.6	8.79	fat
	<i>Rhus glabra</i>	kernel	.9257-.9259	190.8-193.8	126.9	semi-drying
	<i>Olea europaea</i>	covering,	.916 -.9196	188.7-203.0	77.28- 91.7	non-
Palmae	<i>Elaeis guineensis</i>	kernel	.9184-.9191	182.3-183.8	86.99- 87.8	drying
		covering,	.9209-.9245	196.3-205.5	53.0 - 57.44	fat
	<i>Astrocaryum vulgare</i>	kernel	.9119	246.3-250.0	10.3 - 17.5	fat
		covering,	.916	196.5-197.2	74.8 - 75.7	fat
		kernel		242.5-243.3	10.4 - 11.2	fat

and seed kernel oils would be more nearly equal, as well as higher than the melting points of the temperate oils. This may be influenced by the size and structure of the fruit. In agreement with this theory the oils from the seed coverings of the Chinese tallow tree (*Sapium sebiferum* Roxb.) and various species of sumac (*Rhus*) have higher melting points than their corresponding seed kernel oils. However, in the cases of the African oil palm (*Elaeis guineensis* Jacq.) and the Tucum palm (*Astrocaryum vulgare* Martens) the kernel oils have higher melting points than oils of the seed coverings;

but it should be noted that all of these oils are from tropical plants and that the kernel oils have higher melting points than the kernel oils of temperate plants. In the case of the olive, another tropical plant, both oils are similar.

WAXES ON STEMS AND LEAVES

Vegetable waxes are for the most part exudations of plant leaves and stems, and mostly occur in small quantities. Of a total of twenty waxes considered four are found on plants growing in temperate climates and twelve are from tropical or sub-tropical plants.

These waxes occur in the Gramineae, Palmae, Moraceae, Papaveraceae, Saxifragaceae, Linaceae, Euphorbiaceae, Malvaceae, Bombacaceae, Asclepiadaceae, and Compositae.

OILS IN RELATION TO SPECIES

Iodine numbers, saponification values, and specific gravities of the various oils may shed some light on specificity.

The attached tables may be of value in qualitative analysis and an aid to the determination of any oil on the list. For instance, we may have an oil of unknown origin with a saponification number of 114.5, an iodine number of 132.6–157.5, and a specific gravity number of .924–.927 at 15°C. Referring to the list of iodine numbers we find that it may be the oil of *Couepia grandifolia*, *Lepidium sativum*, *Manihot Glaziovii*, *Hevea brasiliensis*, *Helianthus annuus*, *Glycine hispida*, *Guizotia abyssinica*, *Aleurites ricinodendron*, *Amooria Rohituka*, *Juglans regia*, *Papaver somniferum*, or any of some forty-nine other plants. However, when we note the determined saponification number of 114.5 we find the number of plants that will correspond is restricted to *Linum usitatissimum* and *Papaver somniferum*. As *Linum usitatissimum* does not have an iodine value within the specified range, the oil must be of *Papaver somniferum*, provided, of course, the source plant is among those listed.

OILS IN RELATION TO GENERA

There is close agreement between the oils of the different species of a genus. For instance, in the genus *Trifolium*:

Trifolium agrarium: sp. gr. at 15°C., 0.9290; N_d 30°C., 1.4757; sap. v. 188.4; iod. v. 75.9; solid. pt. —15°C. *Trifolium hybridum*: sp. gr. at 15°C., 0.9250; N_d 30°C., 1.4757; sap. v. 187.2; iod. v. 65.9; solid. pt. —14°C. *Trifolium incarnatum*: sp. gr. at 15°C., 0.9170; N_d 30°C., 1.4723; sap. v. 181.3; iod. v. 61.6; solid. pt. —9°C. *Tri-*

folium repens: sp. gr. at 15°C., 0.9170; N_D 30°C., 1.4745; sap. v. 189.4; iod. v. 68.5; solid. pt. -16°C.

OILS IN RELATION TO FAMILIES

Oils are found in at least 83 (30 per cent) of the plant families out of the 277 families listed by Engler and Prantl.

Within the smaller families the oils of the respective genera and their species are in close agreement as in the Cruciferae, Cucurbitaceae, Lauraceae, Myristicaceae, Pinaceae, Polygalaceae, Rutaceae, Sapindaceae, Sapotaceae, Simarubaceae, Solanaceae, and the Umbelliferae.

In the large families the oils of the different genera are usually in close agreement when grouped according to tribes. For instance:

Leguminosae

Subfamily I. Mimosoideae: (F)¹ Parkia, (ND) Pentaclethra

Subfamily II. Caesalpinioideae: (SD) Caesalpinia

Subfamily III. Papilionatae:

Tribe 3. Genisteae: (SD) Cytisus, (SD) Spartium, (ND) Lupinus

Tribe 4. Trifolieae: (ND) Trigonella, (ND) Trifolium, (ND) Ornithopus, (ND) Melilotus, (ND) Medicago

Tribe 5. Loteae: (ND) Lotus, (ND) Anthyllis

Tribe 6. Galegeae: (ND) Galega, (D) Robinia, (D) Caragana, (D) Amorpha

Tribe 7. Hedysareae: (ND) Arachis, (ND) Onobrychis

Tribe 8. Viciae: (SD) Vicia, (SD) Cicer, (SD) Pisum, (SD) Lens

Tribe 9. Phaseoleae: (SD) Voandezia, (SD) Cajanus, (SD) Dolichos, (SD) Canavalia, (SD) Mucuna urens, (SD) Vigna, (SD) Phaseolus Mungo, (SD) Phaseolus lunatus, (SD) Phaseolus inamoenus, (SD) Phaseolus coccineus, (SD) Phaseolus vulgaris, (D) Glycine

Tribe 10. Dalbergieae: (F) Dipteryx, (F) Pongamia

Gramineae

Tribe 1. Paniceae: (D) Panicum

Tribe 2. Maydeae: (SD) Zea

Tribe 3. Oryzeae: (ND) Oryza

Tribe 6. Andropogoneae: (SD) Sorghum

Tribe 7. Phalarideae: (SD) Phalaris

Tribe 12. Hordeae: (SD) Secale, (SD) Triticum, (SD) Hordeum

Cucurbitaceae

Tribe 1. Cumerineae: (F) Hodgsonia, (ND) Telfairia, (F) Luffa, (SD) Acanthosicyus, (SD) Cucumis, (SD) Citrullus, (SD) Cucurbita, (SD) Bryonia

Tribe 3. Elaterieae: (SD) Echinocystis

Guttiferae

Tribe 2. Moronobeae: (F) Symphonia, (F) Pentadesma

Tribe 3. Garcinieae: (F) Garcinia

Tribe 4. Calophylleae: (ND) Calophyllum, (ND) Mesua

¹The abbreviation D = drying oil, SD = semi-drying oil, ND = non-drying oil, and F = fat.

OILS OF TROPICAL AND SUBTROPICAL PLANTS

Of the 83 plant families known to contain oils, 40, or 48.1 per cent, are mainly tropical or subtropical in habitat. According to these statistics, therefore, oils are more frequently found in tropical and subtropical than in plants of temperate regions.

Of the 62 drying oils, 25, or 40 per cent, are from tropical and subtropical plants. Drying oils are therefore not as frequently met with in tropical plants as in plants grown elsewhere.

Of the 83 semi-drying oils, 41, or 49 per cent, are from tropical plants.

Of the 71 non-drying oils, 42, or 59 per cent, are from tropical plants.

Of the 102 fats, 101, or 99.97 per cent, are from tropical plants.

From these data it may be concluded that tropical and subtropical plants are more likely to have fats (highest melting-point oils) than non-drying, semi-drying, or drying oils (lower melting-point oils).

The percentages of drying oils, semi-drying oils, non-drying oils, and fats increase among tropical plants as follows: drying 7.86 per cent, semi-drying 12.89 per cent, non-drying 13.2 per cent, and fats 31.76 per cent.

CHARACTER OF OILS IN RELATION TO CLIMATE OF HABITAT

HABITAT	DRYING OILS		SEMI-DRYING OILS		NON-DRYING OILS		FATS	
	No.	%	No.	%	No.	%	No.	%
Tropical	25	7.86	41	12.89	42	13.2	101	31.76
Temperate	37	11.63	42	13.20	29	9.12	1	00.03
Total	78	19.49	133	26.10	90	22.32	105	31.67

OILS OF NON-TROPICAL AND NON-SUBTROPICAL PLANTS

Of the 83 plant families known to contain oils, 15, or 18.0 per cent, are mainly temperate in habitat.

Of the 62 drying oils, 37, or 59 per cent, are from plants growing in temperate climates. Of the 83 semi-drying oils, 42 are from temperate plants. Of the 71 non-drying oils, 29 are from plants growing in temperate zones.

Of the 102 fats only one is from a plant growing in a temperate climate.

From these data it may be concluded that plants growing in temperate climates are more likely to have drying oils (lower melting-point oils) than semi-drying or non-drying oils and fats (higher melting-point oils).

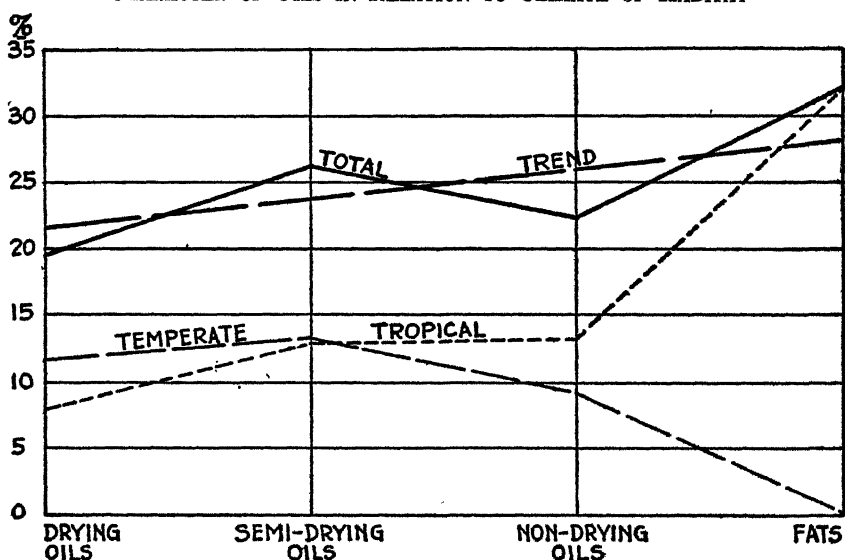
The percentages of drying, semi-drying, non-drying oils, and fats increase in plants growing in temperate habitats as follows: fats .03 per cent, non-drying oils 9.15 per cent, drying oils 11.63 per cent, and semi-drying oils 13.2 per cent.

Drying and semi-drying oils are therefore of more frequent occurrence in plants growing in temperate climates than in tropical plants.

OILS IN RELATION TO PLANT ORIGINS

As to a possible relation between the melting points of oils and tropical origin the following families with high melting-point oil are

CHARACTER OF OILS IN RELATION TO CLIMATE OF HABITAT



of interest (non-drying oils and fats): Cyperaceae, Palmae, Myrsinaceae, Betulaceae, Ulmaceae, Olacaceae, Chenopodiaceae, Lardizabalaceae, Lauraceae, Moringaceae, Tropaeolaceae, Simarubaceae, Burseraceae, Meliaceae, Polygalaceae, Anacardiaceae, Hippocastanaceae, Sapindaceae, Vitaceae, Bombacaceae, Sterculiaceae, Ochnaceae, Caryocaraceae, Theaceae, Guttiferae, Dipterocarpaceae, Flacourtiaceae, Caricaceae, Rhizophoraceae, Combretaceae, Arali-

aceae, Sapotaceae, Oleaceae, Salvadoraceae, Loganiaceae, Asclepiadaceae, Verbenaceae, Bignoniaceae, Rubiaceae, Caprifoliaceae.

It is noted that the majority of these families are mainly tropical in their distribution, notable exceptions being Cyperaceae, Betulaceae, and Chenopodiaceae.

SUMMARY

There may be a relationship between the melting point of a fat or oil of a plant and the temperature of its environment. Such a relationship is known to exist in the case of oils of marine and terrestrial animals.

Oils are found in at least 83 (30 per cent) plant families out of 277 listed by Engler and Prantl.

Some 318 oils have been studied from these 83 families: 62 are drying, 83 are semi-drying, 71 are non-drying, and 102 are fats.

Oils found in seed coverings may have higher melting points than oils of seed kernels.

Waxes are found more abundantly on tropical plants than on plants of temperate climates.

There is close agreement between the oils of the different species of a genus.

The physical and chemical properties of oils may be more or less definitely correlated with specificity.

Tables of iodine numbers, saponification values, and specific gravities of over 300 oils are included. These may aid in differential analysis.

The oils of most of the smaller families are in close intrafamilial agreement, while those of the larger families are often in better agreement considered in tribal groups.

Tropical and subtropical plants are more likely to have fats and non-drying oils than semi-drying or drying oils, i.e., tropical and subtropical oils have higher melting points than the oils of temperate climates.

As to the possible relation between high melting-point oils and tropical origin a list of 40 families is given. Of this list three are mainly temperate in habitat.

SAPONIFICATION VALUES OF OILS, FATS AND WAXES

2.49	<i>Attalea funifera</i>	176.7 -186.6	<i>Ricinus communis</i>
46.76- 60.0	<i>Pedilanthus Pavonis</i>	176.8	<i>Ptychotis ajowan</i>
50.3 - 51.3	<i>Raphia Ruffa</i>	177.3	<i>Sinapis chinensis</i>
62.9 - 63.1	<i>Euphorbia antisyphlitica</i>	178.0 -183.0	<i>Hydnocarpus edulis</i>
63.0(?)	<i>Coriandrum sativum</i>	178.0 -185.1	<i>Pongamia glabra</i>
65.8	<i>Philadelphus coronarius</i>	178.0 -186.4	<i>Lepidium sativum</i>
78.4 - 88.3	<i>Corypha cerifera</i>	178.1	<i>Tilia americana</i>
101.51-162.0	<i>Linum usitatissimum</i>	178.1	<i>Apium graveolens</i>
113.0(?)	<i>Pyrus communis</i>	178.2	<i>Sinapis dissecta</i>
114.5	<i>Papaver somniferum</i>	178.22	<i>Mucuna urens</i>
140.0	<i>Euphorbia stenoclada</i>	178.3	<i>Carum Carvi</i>
142.8	<i>Euphorbia xylophyloides</i>	178.3 -178.4	<i>Pimpinella Anisum</i>
153.0 -191.0	<i>Myristica officinalis</i>	178.4 -191.4	<i>Secale cornutum</i>
156.2	<i>Picramnia carpinterae</i>	179.0 -205.7	<i>Stillingia sebifera</i>
157.0	<i>Acer platanoides</i>	179.1 -192.6	<i>Aleurites moluccana</i>
157.1	<i>Rhus laurina</i>	179.3	<i>Cuminum Cyminum</i>
159.6	<i>Vohemaria Messeri</i>	179.4	<i>Sinapis arvensis</i>
165.1 -177.5	<i>Coffea arabica</i>	179.4	<i>Daucus Carota</i>
165.58-191.6	<i>Pistacia vera</i>	179.4 -193.5	<i>Oryza sativa</i>
166.2 -170.6	<i>Strychnos nux-vomica</i>	179.5	<i>Crambe maritima</i>
167.9	<i>Saccharum officinarum</i>	179.5	<i>Palaquium sp. (Surin fat)</i>
168.5	<i>Fraxinus excelsior</i>	179.6	<i>Kickxia elastica</i>
170.0(?)	<i>Laurus indica</i>	179.7 -197.8	<i>Prunus Cerasus</i>
170.1(?)	<i>Sapindus rarak</i>	179.8	<i>Acer Pseudo-platanus</i>
170.14	<i>Ceiba pentandra</i>	179.9	<i>Eriobotrya japonica</i>
170.3 -177.8	<i>Sinapis alba</i>	180.0	<i>Barbarea praecox</i>
170.4	<i>Eruca sativa</i>	180.3(?)	<i>Cheiranthus Cheira</i>
170.8	<i>Hyoscyamus niger</i>	180.5	<i>Vicia sativa</i>
170.9	<i>Nasturtium Nasturtium-aquaticum</i>	180.7 -194.6	<i>Lophira alata</i>
171.3(?)	<i>Ribes rubrum</i>	181.0 -205.0	<i>Ceiba pentandra</i>
171.3 -180.1	<i>Brassica Napus</i>	181.2	<i>Foeniculum officinale</i>
171.52	<i>Asclepias gigantea</i>	181.2	<i>Isatis tinctoria</i>
171.6	<i>Brassica campestris</i>	181.3	<i>Trifolium incarnatum</i>
171.8 -192.3	<i>Butyrospermum Parkii</i>	181.4	<i>Acanthosicyos horrida</i>
172.1	<i>Brassica juncea</i>	181.75-187.7	<i>Cydonia vulgaris</i>
172.1	<i>Sorghum cernuum</i>	181.9 -203.0	<i>Pentaclethra macrophylla</i>
172.26-175.3	<i>Brassica sp. (Jamba oil)</i>	182.0	<i>Coriandrum sativum</i>
172.3	<i>Medicago sativa</i>	182.0 -190.0	<i>Sinapis nigra</i>
172.8	<i>Crataegus Oxyacantha</i>	182.3 -183.8	<i>Olea europea var. sativa (seed)</i>
172.9 -178.5	<i>Brassica campestris</i>	182.3 -198.2	<i>Prunus Armeniaca</i>
173.0 -183.1	<i>Ximenia americana</i>	182.4	<i>Lens esculenta</i>
173.4	<i>Armoracia rusticana</i>	182.5	<i>Amorpha fruticosa</i>
173.4 -212.01	<i>Sterculia foetida</i>	182.5 -188.6	<i>Mimusops Djave</i>
173.6	<i>Lecythis ollaria</i>	182.6	<i>Cicer arietinum</i>
173.8 -181.6	<i>Raphanus sativus</i>	182.8 -190.3	<i>Triticum sp.</i>
174.0 -176.0	<i>Raphanus Raphanistrum</i>	183.0	<i>Tamarindus indica</i>
174.4	<i>Eruca sativa</i>	183.1	<i>Anthriscus Cerefolium</i>
174.4 -180.3	<i>Brassica oleracea</i>	183.1	<i>Vicia sepium</i>
174.5 -193.05	<i>Poga oleosa</i>	183.2	<i>Pithecoctenium echinatum</i>
174.7 -178.9	<i>Brassica Rapa</i>	183.4	<i>Trigonella Foenum-graecum</i>
175.1(?)	<i>Galega officinalis</i>	183.6 -192.0	<i>Lycopersicum esculentum</i>
175.2	<i>Onobrychis sativa</i>		
176.0	<i>Anethum graveolens</i>		
176.3	<i>Garcinia tonkinensis</i>		
176.5	<i>Petroselinum sativum</i>		

183.8	<i>Setaria italica</i>	188.5	<i>Cephalotaxus drupacea</i>
184.0	<i>Phalaris canariensis</i>	188.5 -190.5	<i>Jessenia polycarpa</i>
184.1	<i>Voandzeia subterranea</i>	188.6	<i>Cupressus sempervirens</i>
184.5	<i>Pisum sativum</i>	188.6	<i>Linaria reticulata</i>
184.5	<i>Parkia africana</i>	188.6 -192.6	<i>Manihot Glaziovii</i>
184.5 -198.9	<i>Payena oleifera</i>	188.6 -195.3	<i>Couepia grandifolia</i>
184.6 -187.7	<i>Moringa oleifera</i>	188.7	<i>Phaseolus inamoenus</i>
184.7	<i>Vicia Faba</i>	188.7 -191.9	<i>Vateria indica</i>
184.7 -191.6	<i>Ricinodendron africanum</i>	188.7 -203.0	<i>Olea europea</i> var. <i>sativa</i> (pulp)
184.8	<i>Tilia parvifolia</i>	188.8	<i>Limonia Warneckeii</i>
185.0	<i>Lallemantia iberica</i>	188.9 -192.2	<i>Guizotia abyssinica</i>
185.0	<i>Lupinus luteus</i>	189.3	<i>Pinus monophylla</i>
185.0	<i>Funtumia elastica</i>	189.0	<i>Anthyllis vulneraria</i>
185.0	<i>Sterculia appendiculata</i>	189.0 -196.8	<i>Papaver somniferum</i>
185.0	<i>Dialyanthera otoba</i>	189.2	<i>Phaseolus vulgaris</i> var. <i>albus</i>
185.1 -196.0	<i>Elaeococca vernicia</i>	189.2	<i>Parthenocissus quinquefolia</i>
185.3	<i>Ornithopus sativus</i>	189.2 -190.0	<i>Echinops ritro</i>
185.6	<i>Vigna Catjang</i>	189.1 -192.5	<i>Prunus Persica</i>
185.6 -196.9	<i>Melia Azadirachta</i>	189.2	<i>Phaseolus lunatus</i>
185.6 -197.0	<i>Arachis hypogaea</i>	189.4	<i>Carthamnus Oxyacantha</i>
185.6 -206.1	<i>Hevea brasiliensis</i>	189.4	<i>Trifolium repens</i>
185.8 -188.0	<i>Myagrum sativum</i>	189.5	<i>Rubus fruticosus</i>
186.0 -194.6	<i>Bassia butyracea</i>	189.5	<i>Trigonella Foenum-graecum</i>
186.0 -202.0	<i>Datura Stramonium</i>	189.5	<i>Trifolium repens</i>
186.2	<i>Lupinus angustifolius</i>	189.5 -191.5	<i>Bassia Mottleyana</i>
186.5	<i>Canavalia ensiformis</i>	189.5 -195.4	<i>Prunus Amygdalus</i>
186.5 -197.5	<i>Joliffa africana</i>	189.6	<i>Pinus montana</i>
186.58	<i>Carica Papaya</i>	189.6	<i>Phaseolus coccineus</i>
186.6 -191.7	<i>Steatodendron Stuhlmannii</i>	189.6	<i>Carya ovata</i>
186.6 -193.3	<i>Carthamnus tinctorius</i>	189.7	<i>Coula edulis</i>
186.7	<i>Thuja occidentalis</i>	189.7 -191.8	<i>Citrullus vulgaris</i>
186.7 -202.9	<i>Citrullus Colocynthis</i>	189.7 -192.3	<i>Amoora Rohituka</i>
186.8 -192.6	<i>Canarium pachyphyllum</i>	189.7 -192.6	<i>Zea Mays</i>
186.8 -191.5	<i>Garcinia indica</i>	189.7 -200.2	<i>Canarium polyphyllum</i>
187.0 -192.0	<i>Cucumis Chate</i>	189.8	<i>Juglans Sieboldiana</i>
187.2	<i>Trifolium hybridum</i>	189.8	<i>Pinus sylvestris</i>
187.4 -188.5	<i>Bassia longifolia</i>	189.8 -192.0	<i>Aleurites cordata</i>
187.5	<i>Dolichos Lablab</i>	189.9	<i>Trifolium pratense</i> var. <i>perenne</i>
187.5	<i>Phaseolus Mungo</i>	189.9 -192.4	<i>Adansonia Grandidieri</i>
187.6	<i>Manniophyton fulvum</i>	190.0	<i>Nicotiana Tabacum</i>
187.8 -190.3	<i>Argemone mexicana</i>	190.0 -193.0	<i>Cannabis sativa</i>
187.8 -195.8	<i>Luffa aegyptiaca</i>	190.1	<i>Vaccinium Vitis-idaea</i>
187.9	<i>Melilotus albus</i>	190.2 -192.7	<i>Linum usitatissimum</i>
187.9 -194.6	<i>Strophanthus hispidus</i>	190.3	<i>Omphalea megacarpa</i>
188.0	<i>Pinus cembra</i>	190.4	<i>Vaccinium Myrtillus</i>
188.0	<i>Diospyros virginiana</i>	190.5	<i>Cucumis Melo</i>
188.0	<i>Vicia Faba</i>	190.5	<i>Celosia cristata</i>
188.0 -193.0	<i>Sesamum indicum</i>	190.5	<i>Pinus Picea</i>
188.0 -194.0	<i>Helianthus annuus</i>	190.5	<i>Hedera Helix</i>
188.1	<i>Caryodendron orinocense</i>	190.5 -191.7	<i>Adansonia digitata</i>
188.1 -198.5	<i>Prunus domestica</i>	190.6	<i>Caragana arborescens</i>
188.2	<i>Cajanus bicolor</i>	190.6 -192.5	<i>Glycine hispida</i>
188.3	<i>Acrocomia sclerocarpa</i>	190.7	<i>Lotus corniculatus</i>
188.3 -195.5	<i>Thea sasangua</i>	190.8 -193.8	<i>Rhus glabra</i>
188.3 -196.2	<i>Bassia villosa</i>	190.9	<i>Petroselinum sativum</i>
188.4	<i>Torreya nucifera</i>	190.9 -193.4	<i>Perilla nankinensis</i>
188.4	<i>Citrus Limonia</i>		
188.4	<i>Melampyrum arvense</i>		
188.4	<i>Trifolium agrarium</i>		
188.4 -190.2	<i>Cucurbita Pepo</i>		

191.0	<i>Calophyllum inophyllum</i>	194.15	<i>Sterculia chica</i>
191.0	<i>Cannabis sativa</i>	194.5	<i>Nigella sativa</i>
191.0 -192.0	<i>Ungnadia speciosa</i>	194.5	<i>Aesculus Hippocastanum</i>
191.0 -194.5	<i>Gossypium</i> sp. (cotton)	194.6	<i>Gynandropsis pentaphylla</i>
191.1	<i>Lactuca Scariola</i> var. <i>oleifera</i>	194.6	<i>Moronobea coccinea</i>
191.1 -196.3	<i>Fagus sylvatica</i>	194.6	<i>Blighia sapida</i>
191.2	<i>Shorea aptera</i>	194.74	<i>Garcinia morella</i>
191.3	<i>Torreya californica</i>	194.9 -197.1	<i>Cucurbita maxima</i>
191.3	<i>Pinus Gerardiana</i>	195.0	<i>Anacardium occidentale</i>
191.3	<i>Morus alba</i>	195.0	<i>Lycopodium</i>
191.5	<i>Melia Azedarach</i>	195.2	<i>Oenothera biennis</i>
191.5	<i>Cucurbita maxima</i>	195.2	<i>Citrus aurantifolia</i>
191.5 -195.2	<i>Ricinodendron Rautanenii</i>	195.2	<i>Abelmoschus esculentus</i>
191.8	<i>Pinus Cembra</i>	195.2 -196.9	<i>Cucumis sativus</i>
191.8	<i>Hesperis matronalis</i>	195.5	<i>Vitis vinifera</i>
191.8 -202.0	<i>Theobroma Cacao</i>	195.6 -197.2	<i>Carapa guianensis</i>
191.9	<i>Thea japonica</i>	195.7 -196.2	<i>Cucurbita Pepo</i>
191.9	<i>Thea sinensis</i>	195.98	<i>Citrus Limonia</i>
192.0	<i>Pentadesma Kerstingii</i>	196.0	<i>Secale cereale</i>
192.0	<i>Chisocheton Cumingianus</i>	196.3 -205.5	<i>Elaeis guineensis</i>
192.0	<i>Plukenetia conophora</i>	196.42	<i>Calotropis gigantea</i>
192.0	<i>Maclura pomifera</i>	196.5	<i>Daphne Cnidium</i>
192.0	<i>Pinus Abies</i>	196.5	<i>Moquilea tomentosa</i>
192.0 -192.5	<i>Cornus sanguinea</i>	196.5 -197.2	<i>Astrocaryum vulgare</i>
192.12	<i>Argania sideroxylon</i>	196.6	<i>Lappa minor</i>
192.3	<i>Rubus idaeus</i>	196.8 -209.3	<i>Sambucus racemosa</i>
192.4	<i>Robinia Pseudoacacia</i>	197.0	<i>Gynocardia odorata</i>
192.4	<i>Oncoba echinata</i>	197.0	<i>Canarium oleosum</i>
192.6	<i>Cytisus Laburnum</i>	197.0	<i>Canarium luzonicum</i>
192.6	<i>Pinus Pineae</i>	197.0	<i>Pentadesma butyracea</i>
192.7	<i>Picramnia Lindeniana</i>	197.0 -210.0	<i>Laurus nobilis</i>
192.8	<i>Madia sativa</i>	197.1	<i>Martynia louisiana</i>
192.8	<i>Pinus monophylla</i>	197.25	<i>Basiloxylon brasiliensis</i>
192.8	<i>Lupinus albus</i>	197.6	<i>Hodgsonia Kadam</i>
192.8 -197.1	<i>Corylus Avellana</i>	197.6 -199.5	<i>Caryocar butyrosun</i>
192.9 -215.6	<i>Croton Tiglium</i>	198.0	<i>Carya Pecan</i>
193.0	<i>Parthenocissus quinquefolia</i>	198.0	<i>Trichilia emetica</i>
193.0	<i>Bryonia dioica</i>	198.1	<i>Carapa grandiflora</i>
193.2	<i>Jatropha Curcas</i>	198.2	<i>Citrullus vulgaris</i>
193.4	<i>Medicago sativa</i>	198.4	<i>Datura Metel</i>
193.4	<i>Illicium religiosum</i>	198.5	<i>Skaphium lanceatum</i>
193.4	<i>Echinocystis oregana</i>	198.5	<i>Xanthophyllum lanceatum</i>
193.4 -194.1	<i>Asparagus officinalis</i>	198.6	<i>Spartium junceum</i>
193.4 -202.0	<i>Bertholletia excelsa</i>	199.3	<i>Quercus agrifolia</i>
193.48	<i>Perilla frutescens</i>	199.5	<i>Aegiphila obducta</i>
193.5 -194.3	<i>Colophonia mauritiana</i>	199.8	<i>Myrtus communis</i>
193.6	<i>Buchanania latifolia</i>	200.3 -213.0	<i>Hydnocarpus Kurzii</i>
193.7	<i>Fragaria vesca</i>	201.5	<i>Croton Elliotianus</i>
193.7 -196.37	<i>Citrus Aurantium</i>	201.5	<i>Palaquium oblongifolium</i>
193.8 -197.3	<i>Juglans regia</i>	201.5	<i>Trichilia subcordata</i>
193.8	<i>Illicium verum</i>	202.0 -203.0	<i>Nerium Oleander</i>
193.8	<i>Polygala Senega</i>	202.0	<i>Pyrus Malus</i>
193.8	<i>Nephelium lappaceum</i>	202.8	<i>Vernonia anthelmintica</i>
193.9	<i>Thea sasanqua</i>	203.0	<i>Hyptis spicigera</i>
194.0	<i>Prunus Laurocerasus</i>	203.0 -204.0	<i>Terminalia Catappa</i>
194.0	<i>Jatropha mahafalensis</i>	203.1	<i>Citrullus Naudinianus</i>
194.0 -196.5	<i>Citrullus vulgaris</i>	203.5 -208.1	<i>Hydnocarpus Wightiana</i>
194.1	<i>Balanites aegyptiaca</i>	203.6	<i>Trichilia emetica</i>
		203.7 -205.8	<i>Mesua ferrea</i>

58 FIELD MUSEUM OF NATURAL HISTORY—BOTANY, VOL. IX

203.8 -210.4	<i>Stillingia sebifera</i>	239.5 -240.2	<i>Myristica platysperma</i>
205.0	<i>Magnolia hypoleuca</i>	241.2 -250.0	<i>Irvingia</i> spp.
205.7 -217.0	<i>Myricacerifera</i>	241.39	<i>Machilus Thunbergii</i>
205.9	<i>Pithecolobium dulce</i>	242.2	<i>Allophylus racemosa</i>
206.2 -212.0	<i>Hydnocarpus anthe- lenticus</i>	242.36	<i>Salvadora oleoides</i>
208.0	<i>Sorbus Aucuparia</i>	242.5 -243.3	<i>Astrocaryum vulgare</i>
208.0	<i>Arbutus Unedo</i>	244.0	<i>Myristica surinamensis</i>
209.2	<i>Oenocarpus distichus</i>	244.7	<i>Litsea zeylanica</i>
210.98	<i>Phoenix dactylifera</i>	245.2	<i>Salvadora persica</i>
211.0	<i>Betula alba</i>	246.2	<i>Mauritia vinifera</i>
213.9	<i>Mimusops elengi</i>	246.3 -250.0	<i>Elaeis guineensis</i>
215.02	<i>Myristica canarica</i>	246.4	<i>Akebia quinata</i>
215.3 -227.0	<i>Schleichera trijuga</i>	251.0	<i>Polygala butyracea</i>
216.2	<i>Chorisia Peckoltiana</i>	251.0 -268.4	<i>Cocos nucifera</i>
217.5 -237.5	<i>Rhus sylvestris</i>	252.4 -256.5	<i>Attalea cohune</i>
218.8 -220.3	<i>Virola bicuhyba</i>	255.0	<i>Myristica angolensis</i>
220.6	<i>Rhus diversiloba</i>	255.6	<i>Lindera sericea</i>
221.5	<i>Virola guatemalensis</i>	256.6 -349.0	<i>Attalea excelsa</i>
223.5(?)	<i>Celastrus senegalensis</i>	262.2	<i>Telfairia occidentalis</i>
224.4	<i>Magnolia hypoleuca</i>	268.2	<i>Lepidadenia Wightiana</i>
224.72	<i>Cyperus esculentus</i>	270.0(?)	<i>Capsicum annuum</i>
227.4 -234.6	<i>Areca catechu</i>	273.6	<i>Lindera praecox</i>
229.2	<i>Luffa acutangula</i>	277.3	<i>Ulmus campestris</i>
234.8	<i>Apeiba</i> sp.	280.0	<i>Hordeum vulgare</i>
235.0 -235.6	<i>Irvingia Oliveri</i>	282.0	<i>Lindera triloba</i>
238.5	<i>Scyphocephalum ochocoa</i>	283.8	<i>Cinnamomum Cam- phora</i>
		339.6(?)	<i>Citrus aurantifolia</i>

SPECIFIC GRAVITY OF OILS, FATS AND WAXES AT 15° C.

0.882 -0.836	<i>Raphia Ruffa</i>	.9137- .9167	<i>Mimusops Djave</i>
.8594- .9177	<i>Butyrospermum Parkii</i>	.9143	<i>Citrullus vulgaris</i>
.865	<i>Mucuna urens</i>	.9147	<i>Canarium polyphyllum</i>
.866	<i>Polygala butyracea</i>	.9148	<i>Brassica campestris</i>
.867	<i>Salvadora persica</i>	.9149	<i>Melia Azadirachta</i>
.868	<i>Attalea funifera</i>	.915 - .921	<i>Jatropha Curcas</i>
.868 - .871	<i>Attalea cohune</i>	.915	<i>Adansonia digitata</i>
.8686	<i>Attalea excelsa</i>	.915	<i>Vateria indica</i>
.8715	<i>Virola bicuhyba</i>	.915 - .918	<i>Stillingia sebifera</i>
.8916	<i>Lepidadenia Wightiana</i>	.915 - .9158	<i>Brassica</i> sp. (Jamba oil)
.8943- .9175	<i>Bassia villosa</i>	.9155- .917	<i>Corylus Avellana</i>
.895(?)	<i>Lecythis ollaria</i>	.9156	<i>Caryocar tomentosum</i>
.898	<i>Oncoba echinata</i>	.9158	<i>Brassica juncea</i>
.9002	<i>Luffa acutangula</i>	.9158	<i>Blighia sapida</i>
.9011	<i>Rhus laurina</i>	.9158	<i>Trichilia emetica</i>
.9072	<i>Torreya californica</i>	.9158- .9558	<i>Bassia butyracea</i>
.9072- .9171	<i>Sambucus racemosa</i>	.916 - .9196	<i>Olea europea</i> var. <i>sativa</i>
.9083- .998	<i>Linum usitatissimum</i>	.916	<i>Astrocaryum vulgare</i>
.9092- .9285	<i>Prunus Cerasus</i>	.916	<i>Thea japonica</i>
.9099- .9225	<i>Fagus sylvatica</i>	.916 - .9213	<i>Prunus domestica</i>
.9119	<i>Elaeis guineensis</i>	.9161	<i>Jessenia polycarpa</i>
.912	<i>Carapa guianensis</i>	.9162	<i>Quercus agrifolia</i>
.912	<i>Ribes rubrum</i>	.9163	<i>Thea sasanqua</i>
.9125	<i>Picramnia Lindeniana</i>	.9164	<i>Pentaclethra macro- phylla</i>
.9126- .916	<i>Sinapis alba</i>	.9165- .920	<i>Arachis hypogaea</i>
.9127- .920	<i>Moringa oleifera</i>	.9165- .9178	<i>Raphanus sativus</i>
.9127-	<i>Garcinia tonkinensis</i>	.9165- .9248	<i>Ximenia americana</i>
.9127	<i>Garcinia indica</i>	.9169	<i>Canavalia ensiformis</i>
.9128- .9225	<i>Canarium commune</i>	.917	<i>Trifolium incarnatum</i>
.9187	<i>Sorbus Aucuparia</i>		

.917	<i>Trifolium repens</i>	.922	<i>Cydonia vulgaris</i>
.917 - .920	<i>Brassica Rapa</i>	.9221	<i>Sinapis dissecta</i>
.917	<i>Bassia Mottleyana</i>	.9222- .9279	<i>Glycine hispida</i>
.917 - .927	<i>Thea sasanqua</i>	.9224- .926	<i>Myagrum sativum</i>
.9172	<i>Canarium pachyphyllum</i>	.9225	<i>Datura Metel</i>
.9172- .921	<i>Brassica Napus</i>	.9226	<i>Strychnos Nux-vornica</i>
.9175	<i>Vicia Faba</i>	.9228	<i>Sinapis arvensis</i>
.9175- .9186	<i>Raphanus Raphanistrum</i>	.923	<i>Sinapis chinensis</i>
.9175- .921	<i>Brassica campestris</i>	.923	<i>Anthyllis vulneraria</i>
.9175- .923	<i>Datura Stramonium</i>	.923 - .926	<i>Sesamum indicum</i>
.9176	<i>Voandezia subterranea</i>	.923 - .924	<i>Cucumis sativus</i>
.9177	<i>Eruca sativa</i>	.923	<i>Prunus Laurocerasus</i>
.9177- .9195	<i>Prunus Amygdalus</i>	.923 - .925	<i>Cucurbita Pepo</i>
.9178	<i>Thea sinensis</i>	.923 - .925	<i>Gossypium sp. (cotton)</i>
.9179	<i>Phaseolus vulgaris var. albus</i>	.9232	<i>Armoracia rusticana</i>
.918	<i>Bertholletia excelsa</i>	.9232	<i>Pimpinella Anisum</i>
.918 - .9185	<i>Telfairia pedata</i>	.9232	<i>Nicotiana Tabacum</i>
.918 - .9215	<i>Prunus Persica</i>	.9235	<i>Lupinus angustifolius</i>
.9184	<i>Carya Pecan</i>	.9235	<i>Lupinus luteus</i>
.9184	<i>Cicer arietinum</i>	.9235	<i>Lupinus albus</i>
.9184- .9191	<i>Olea europea var. sativa</i>	.9235- .9236	<i>Melia Azedarach</i>
.9184- .922	<i>Citrullus vulgaris</i>	.9236	<i>Ceiba pentandra</i>
.9185- .9188	<i>Pistacia vera</i>	.9236	<i>Apium graveolens</i>
.9186	<i>Coula edulis</i>	.9237	<i>Daphne Cnidium</i>
.9187	<i>Adansonia Grandidieri</i>	.9238	<i>Torreya nucifera</i>
.9187	<i>Crambe maritima</i>	.9238- .9258	<i>Manihot Glaziovii</i>
.919	<i>Hodgsonia Kadam</i>	.9239	<i>Vicia sativa</i>
.919 - .923	<i>Sinapis nigra</i>	.9239- .9302	<i>Hevea brasiliensis</i>
.919 - .926	<i>Cucurbita maxima</i>	.924	<i>Pimpinella Anisum</i>
.9191	<i>Chelidonium majus</i>	.924	<i>Cheiranthus Cheira</i>
.9191- .9219	<i>Lophira alata</i>	.924	<i>Cucumis Chate</i>
.9192- .9256	<i>Trichilia emetica</i>	.924 - .926	<i>Schleichera trijuga</i>
.9193	<i>Pisum sativum</i>	.924 - .927	<i>Helianthus annuus</i>
.9195(?)	<i>Rhamnus cathartica</i>	.9241	<i>Papaver somniferum</i>
.9198	<i>Phaseolus coccineus</i>	.9241	<i>Viola guatemalensis</i>
.9198	<i>Eruca sativa</i>	.9243	<i>Petroselinum sativum</i>
.9198- .9226	<i>Brassica oleracea</i>	.9244	<i>Diospyros virginiana</i>
.920	<i>Diallyanthra otoba</i>	.9244	<i>Myrtus communis</i>
.920 - .9238	<i>Lepidium sativum</i>	.9245	<i>Delphinium elatum</i>
.920 - .926	<i>Aleurites moluccana</i>	.9245	<i>Morus alba</i>
.920	<i>Balanites aegyptiaca</i>	.9245- .9374	<i>Triticum sp. (wheat)</i>
.9203	<i>Chisocheton Cumingianus</i>	.9247- .9259	<i>Argemone mexicana</i>
.9204	<i>Prunus Armeniaca</i>	.9248	<i>Juglans Sieboldiana</i>
.9205	<i>Nasturtium Nasturtium-aquaticum</i>	.9248	<i>Nigella sativa</i>
.9206	<i>Mauritia vinifera</i>	.9248- .9263	<i>Guizotia abyssinica</i>
.9208	<i>Lens esculenta</i>	.9249	<i>Cucurbita maxima</i>
.9208	<i>Arbutus Unedo</i>	.9249	<i>Strophanthus hispidus</i>
.9209- .9245	<i>Elaeis guineensis</i>	.925	<i>Cephalotaxus drupacea</i>
.921 - .9225	<i>Cornus sanguinea</i>	.925	<i>Myristica surinamensis</i>
.921 - .926	<i>Luffa aegyptiaca</i>	.925	<i>Trifolium hybridum</i>
.9212	<i>Medicago sativa</i>	.925 - .927	<i>Secale cornutum</i>
.9213	<i>Jatropha mahafalensis</i>	.925 - .931	<i>Cannabis sativa</i>
.9214	<i>Barbarea praecox</i>	.9251	<i>Isatis tinctoria</i>
.9214	<i>Scyphocephalum ochocoa</i>	.9252	<i>Linaria reticulata</i>
.9215	<i>Ornithopus sativus</i>	.9255	<i>Payena oleifera</i>
.9215- .922	<i>Zea Mays</i>	.9256	<i>Cuminum Cyminum</i>
.9219	<i>Citrullus vulgaris</i>	.9256	<i>Rubus fruticosus</i>
.922	<i>Onobrychis sativa</i>	.9256- .9265	<i>Juglans regia</i>
		.9257- .9259	<i>Rhus glabra</i>
		.9259	<i>Cocos nucifera</i>
		.926	<i>Laurus indica</i>
		.926	<i>Aesculus Hippocastanum</i>

.926 - .928	<i>Cucurbita Pepo</i>	.9337	<i>Cinnamomum Camphora</i>
.9262	<i>Dolichos Lablab</i>		
.9264	<i>Illicium verum</i>	.9342	<i>Perilla frutescens</i>
.9265	<i>Garcinia morella</i>	.9345	<i>Fragaria vesca</i>
.9265	<i>Arctostaphylos Cerefolium</i>	.9346	<i>Carapa grandiflora</i>
.9266	<i>Croton Elliotianus</i>	.935	<i>Trigonella Foenum-graecum</i>
.9267	<i>Ptychotis ajowan</i>		
.9267- .9277	<i>Carthamnus tinctorius</i>	.9352	<i>Anethum graveolens</i>
.9268	<i>Carum Carvi</i>	.9355- .9382	<i>Ricinodendron africanum</i>
.9268	<i>Cajanus bicolor</i>		
.9268	<i>Pinus Picea</i>	.936	<i>Plukenetia conophora</i>
.9269	<i>Arctium Lappa</i>	.936	<i>Aleurites cordata</i>
.927	<i>Pentadesma butyracea</i>	.936 - .993	<i>Pedilanthus Pavonis</i>
.9275	<i>Apeiba</i>	.9369	<i>Pongamia glabra</i>
.9275	<i>Setaria italica</i>	.937	<i>Lotus corniculatus</i>
.9276	<i>Cucumis Melo</i>	.937 - .939	<i>Perilla nankinensis</i>
.9276	<i>Phaseolus inamoenus</i>	.9371	<i>Lallemantia iberica</i>
.928	<i>Asparagus officinalis</i>	.938	<i>Tilia americana</i>
.928	<i>Galega officinalis</i>	.938	<i>Meililotus albus</i>
.9281	<i>Cajanus bicolor</i>	.938	<i>Telfairia occidentalis</i>
.9282	<i>Phaseolus lunatus</i>	.939	<i>Hyoscyamus niger</i>
.9282	<i>Sorghum cernuum</i>	.939	<i>Euonymus europaea</i>
.9283	<i>Oenothera biennis</i>	.9403	<i>Allophylus racemosa</i>
.9284	<i>Coriandrum sativum</i>	.9406	<i>Crataegus Oxyacantha</i>
.9285- .9286	<i>Madia sativa</i>	.9417	<i>Machilus Thunbergii</i>
.9286	<i>Ricinodendron Rautanenii</i>	.9426	<i>Amorpha fruticosa</i>
		.9435	<i>Celastrus senegalensis</i>
.9288- .932	<i>Echinops ritro</i>	.9437	<i>Croton Tiglium</i>
.9289	<i>Citrullus Colocynthis</i>	.9437	<i>Symphonia globulifera</i>
.929	<i>Sterculia foetida</i>	.945 - .996	<i>Myristica officinalis</i>
.929	<i>Funtunia elastica</i>	.9458	<i>Stillingia sebifera</i>
.929	<i>Trifolium agrarium</i>	.9458	<i>Myristica angolensis</i>
.929	<i>Medicago sativa</i>	.9468	<i>Dipteryx odorata</i>
.9295	<i>Illicium religiosum</i>	.9471	<i>Trigonella Foenum-graecum</i>
.9295	<i>Tilia pravifolia</i>	.9492	<i>Litsea zeylanica</i>
.9296	<i>Daucus Carota</i>	.9495	<i>Oryza sativa</i>
.9298	<i>Stearodendron Stuhlmannii</i>	.951 - .9525	<i>Coffea arabica</i>
		.9518	<i>Bassia longifolia</i>
.9298	<i>Vigna Catjang</i>	.953	<i>Buchanania latifolia</i>
.930	<i>Pinus Cembra</i>	.9577	<i>Vicia Faba</i>
.9301	<i>Vaccinium Vitis-idaea</i>	.958	<i>Hydnocarpus Kurzii</i>
.9304	<i>Foeniculum officinale</i>	.959 - .960	<i>Hydnocarpus anthelmintica</i>
.9307	<i>Pinus Gerardiana</i>		
.9315	<i>Irvingia spp.</i>	.9591- .9679	<i>Ricinus communis</i>
.9315- .9335	<i>Hesperis matronalis</i>	.9594	<i>Ulmus campestris</i>
.931 - .9386	<i>Amoora Rohituka</i>	.9625	<i>Euonymus verrucosa</i>
.9316	<i>Pinus Cembra</i>	.9637	<i>Polygala Senega</i>
.9316- .941	<i>Linum usitatissimum</i>	.964 - .976	<i>Theobroma Cacao</i>
.9317	<i>Rubus idaeus</i>	.965	<i>Hydnocarpus Wightianus</i>
.9318	<i>Pinus montana</i>		
.932	<i>Gynocardia odorata</i>	.9656	<i>Aegiphila obducta</i>
.9326	<i>Pinus sylvestris</i>	.9656	<i>Triticum spp. (wheat)</i>
.9327	<i>Kickxia elastica</i>	.967	<i>Eriobotrya japonica</i>
.9328	<i>Dialyanthera otoba</i>	.968	<i>Saccharum officinarum</i>
.9329	<i>Salvadora oleoides</i>	.9694	<i>Couepia grandifolia</i>
.933	<i>Pinus monophylla</i>	.9694	<i>Pithecolobium dulce</i>
.933 - .935	<i>Elaeococca vernicia</i>	.9697- .986	<i>Euphorbia antisiphilitica</i>
.9331	<i>Vaccinium Myrtillus</i>		
.9332- .953	<i>Laurus nobilis</i>	.9717	<i>Mimusops elengi</i>
.9336	<i>Palaquium sp.</i>	.975	<i>Rhus succedanea</i>
.9336	<i>Phaseolus Mungo</i>	.9786	<i>Ongokea Klaineana</i>

.988	Argania Sideroxylon	1.4718	Pinus monophylla
.9896	Rhus diversiloba	1.4737	Anacardium occidentale
.990 - .999	Corypha cerifera	1.486	Pinus Pinea
.995	Virola sebifera	1.4869	Picramnia carpinterae
.995	Myrica cerifera	1.4935	Thuja occidentalis
1.0115	Ficus cerifua	1.4997	Cupressus sempervirens
1.019	Cannabis sativa		

IODINE NUMBERS OF OILS, FATS AND WAXES

1.03- 3.9	Myrica cerifera	38.4	Nephelium lappaceum
1.72	Scyphocephalum ochocoa	39.4	Allophylus racemosa
		39.9	Trichilia subcordata
2.28- 11.54	Lepidadenia Wightiana	40.1	Luffa acutangula
3.2	Vohemaria Messeri	40.1 - 85.7	Myristica officinalis
3.34- 5.2	Irvingia spp.	41.2 - 46.5	Bassia butyracea
3.6 - 17.35	Attalea excelsa	41.85- 49.5	Caryocar tomentosum
4.2 - 15.1	Rhus sylvestris	41.9	Stearodendron Stuhlmannii
4.5	Cinnamomum Camphora	42.3	Pentadesma butyracea
4.98- 6.3	Myristica platysperma	42.31	Palaquium spp.
5.3	Euphorbia xylophyloides	43.4	Telfairia occidentalis
		44.0	Trichilia emetica
5.9	Euphorbia stenoclada	45.9	Pentadesma Kerstingii
5.9	Salvadora persica	46.5	Litsea zeylanica
6.7 - 6.8	Irvingia Oliveri	48.3 - 69.1	Schleichera trijuga
7.48	Salvadora oleoides	48.7	Eriobotrya japonica
7.7 - 10.7	Raphia Ruffa	49.1	Blighia sapida
8.0 - 10.0	Cocos nucifera	50.1 - 64.0	Bassia longifolia
8.79	Rhus diversiloba	50.7	Carica Papaya
9.5 - 18.5	Virola bicuhyba	50.7	Pithecoctenium echinatum
9.61- 17.0	Linum usitatissimum		
10.3 - 17.5	Elaeis guineensis	52.0	Philadelphus coronarius
10.4 - 11.2	Astrocaryum vulgare	52.31	Phoenix dactylifera
11.0 - 13.7	Attalea cohune	52.5	Polygala butyracea
11.44	Rhus laurina	52.6 - 67.85	Bassia latifolia
11.68	Lindera triloba	52.95- 59.74	Canarium polyphyllum
12.3 - 24.3	Areca catechu	53.0 - 57.44	Elaeis guineensis
12.4	Virola guatemalensis	53.9 - 66.0	Adansonia Grandidieri
13.2 - 13.5	Corypha cerifera	54.0	Dialyanthera otoba
13.8	Myristica surinamensis	54.0 - 67.2	Butyrospermum Parkii
14.0 - 20.0	Pedilanthus Pavonis	55.0	Oenocarpus distichus
15.0	Shorea aptera	55.46	Garcinia morella
15.6	Attalea funifera	56.0 - 57.2	Mimusops Djave
19.0 - 37.7	Stillingia sebifera	56.6	Pithecolobium dulce
20.53	Lindera praecox	56.8	Picramnia Lindeniana
22.6	Cannabis sativa	57.1	Canarium luzonicum
25.0 - 34.2	Garcinia indica	57.3	Buchanania latifolia
25.2	Mauritia vinifera	57.65	Paullinia trigona
26.64	Myristica canarica	58.5 - 72.1	Carapa guianensis
26.9	Acrocomia sclerocarpa	58.62- 63.4	Payena oleifera
32.3	Ulmus campestris	59.61- 61.25	Canarium pachyphyllum
32.8 - 41.7	Theobroma Cacao	60.0	Saccharum officinarum
33.42	Gossypium spp.	60.25	Melia Champaca
34.3	Palaquium oblongifolium	61.4	Chorisia Peckoltiana
		61.6	Trifolium incarnatum
35.06- 57.6	Euphorbia antisiphilitica	61.6	Lupinus albus
		61.8	Galega officinalis
36.6	Xanthophyllum lanceatum	62.3	Cyperus esculentus
		63.0	Canarium oleosum
36.6	Skaphium lanceatum	63.2 - 65.0	Bassia Mottleyana
37.82- 39.63	Vateria indica	63.9	Picramnia carpinterae

.926 - .928	<i>Cucurbita Pepo</i>	.9337	<i>Cinnamomum Camphora</i>
.9262	<i>Dolichos Lablab</i>		<i>Perilla frutescens</i>
.9264	<i>Illicium verum</i>	.9342	<i>Fragaria vesca</i>
.9265	<i>Garcinia morella</i>	.9345	<i>Carapa grandiflora</i>
.9265	<i>Anthriscus Cerefolium</i>	.9346	<i>Trigonella Foenum-graecum</i>
.9266	<i>Croton Elliotianus</i>	.935	
.9267	<i>Ptychotis ajowan</i>		<i>Anethum graveolens</i>
.9267- .9277	<i>Carthamnus tinctorius</i>	.9352	<i>Ricinodendron africanum</i>
.9268	<i>Carum Carvi</i>	.9355- .9382	
.9268	<i>Cajanus bicolor</i>		<i>Plukenetia conophora</i>
.9268	<i>Pinus Picea</i>	.936	<i>Aleurites cordata</i>
.9269	<i>Arctium Lappa</i>	.936	<i>Pedilanthus Pavonis</i>
.927	<i>Pentadesma butyracea</i>	.936 - .993	<i>Pongamia glabra</i>
.9275	<i>Apeiba</i>	.9369	<i>Lotus corniculatus</i>
.9275	<i>Setaria italica</i>	.937	<i>Perilla nankinensis</i>
.9276	<i>Cucumis Melo</i>	.937 - .939	<i>Lallemantia iberica</i>
.9276	<i>Phaseolus inamoenus</i>	.9371	<i>Tilia americana</i>
.928	<i>Asparagus officinalis</i>	.938	<i>Melilotus albus</i>
.928	<i>Galega officinalis</i>	.938	<i>Telfairia occidentalis</i>
.9281	<i>Cajanus bicolor</i>	.938	<i>Hyoscyamus niger</i>
.9282	<i>Phaseolus lunatus</i>	.939	<i>Euonymus europaea</i>
.9282	<i>Sorghum cernuum</i>	.939	<i>Allophylus racemosa</i>
.9283	<i>Oenothera biennis</i>	.9403	<i>Crataegus Oxyacantha</i>
.9284	<i>Coriandrum sativum</i>	.9406	<i>Machilus Thunbergii</i>
.9285- .9286	<i>Madia sativa</i>	.9417	<i>Amorpha fruticosa</i>
.9286	<i>Ricinodendron Rautanenii</i>	.9426	<i>Celastrus senegalensis</i>
		.9435	<i>Croton Tiglium</i>
.9288- .932	<i>Echinops ritro</i>	.9437	<i>Symphonia globulifera</i>
.9289	<i>Citrullus Colocynthis</i>	.9437	<i>Myristica officinalis</i>
.929	<i>Sterculia foetida</i>	.945 - .996	<i>Stillingia sebifera</i>
.929	<i>Funtunia elastica</i>	.9458	<i>Myristica angolensis</i>
.929	<i>Trifolium agrarium</i>	.9458	<i>Dipteryx odorata</i>
.929	<i>Medicago sativa</i>	.9468	<i>Trigonella Foenum-graecum</i>
.9295	<i>Illicium religiosum</i>	.9471	<i>Litsea zeylanica</i>
.9295	<i>Tilia pravifolia</i>	.9492	<i>Oryza sativa</i>
.9296	<i>Daucus Carota</i>	.9495	<i>Coffea arabica</i>
.9298	<i>Stearodendron Stuhlmannii</i>	.951 - .9525	<i>Bassia longifolia</i>
		.9518	<i>Buchanania latifolia</i>
.9298	<i>Vigna Catjang</i>	.953	<i>Vicia Faba</i>
.930	<i>Pinus Cembra</i>	.9577	<i>Hydnocarpus Kurzii</i>
.9301	<i>Vaccinium Vitis-idaea</i>	.958	<i>Hydnocarpus anthelmintica</i>
.9304	<i>Foeniculum officinale</i>	.959 - .960	
.9307	<i>Pinus Gerardiana</i>		<i>Ricinus communis</i>
.9315	<i>Irvingia spp.</i>	.9591- .9679	<i>Ulmus campestris</i>
.9315- .9335	<i>Hesperis matronalis</i>	.9594	<i>Euonymus verrucosa</i>
.931 - .9386	<i>Amoora Rohituka</i>	.9625	<i>Polygala Senega</i>
.9316	<i>Pinus Cembra</i>	.9637	<i>Theobroma Cacao</i>
.9316- .941	<i>Linum usitatissimum</i>	.964 - .976	<i>Hydnocarpus Wightianus</i>
.9317	<i>Rubus idaeus</i>	.965	
.9318	<i>Pinus montana</i>		<i>Aegiphila obducta</i>
.932	<i>Gynocardia odorata</i>	.9656	<i>Triticum spp. (wheat)</i>
.9326	<i>Pinus sylvestris</i>	.9656	<i>Eriobotrya japonica</i>
.9327	<i>Kickxia elastica</i>	.967	<i>Saccharum officinarum</i>
.9328	<i>Dialyanthera otoba</i>	.968	<i>Couepia grandifolia</i>
.9329	<i>Salvadora oleoides</i>	.9694	<i>Pithecolobium dulce</i>
.933	<i>Pinus monophylla</i>	.9694	
.933 - .935	<i>Elaeococca vernicia</i>	.9697- .986	<i>Euphorbia antisyphilitica</i>
.9331	<i>Vaccinium Myrtillus</i>		<i>Mimusops elengi</i>
.9332- .953	<i>Laurus nobilis</i>	.9717	<i>Rhus succedanea</i>
.9336	<i>Palaquium sp.</i>	.975	<i>Ongokea Klaineana</i>
.9336	<i>Phaseolus Mungo</i>	.9786	

.988	Argania Sideroxylon	1.4718	Pinus monophylla
.9896	Rhus diversiloba	1.4737	Anacardium occidentale
.990 - .999	Corypha cerifera	1.486	Pinus Pinea
.995	Virola sebifera	1.4869	Picramnia carpinterae
.995	Myrica cerifera	1.4935	Thuja occidentalis
1.0115	Ficus cerifua	1.4997	Cupressus sempervirens
1.019	Cannabis sativa		

IODINE NUMBERS OF OILS, FATS AND WAXES

1.03- 3.9	Myrica cerifera	38.4	Nephelium lappaceum
1.72	Scyphocephalum ochocoa	39.4	Allophylus racemosa
		39.9	Trichilia subcordata
2.28- 11.54	Lepidadenia Wightiana	40.1	Luffa acutangula
3.2	Vohemaria Messeri	40.1 - 85.7	Myristica officinalis
3.34- 5.2	Irvingia spp.	41.2 - 46.5	Bassia butyracea
3.6 - 17.35	Attalea excelsa	41.85- 49.5	Caryocar tomentosum
4.2 - 15.1	Rhus sylvestris	41.9	Stearodendron Stuhlmannii
4.5	Cinnamomum Camphora	42.3	Pentadesma butyracea
4.98- 6.3	Myristica platysperma	42.31	Palaquium spp.
5.3	Euphorbia xylophylloides	43.4	Telfairia occidentalis
		44.0	Trichilia emetica
5.9	Euphorbia stenoclada	45.9	Pentadesma Kerstingii
5.9	Salvadora persica	46.5	Litsea zeylanica
6.7 - 6.8	Irvingia Oliveri	48.3 - 69.1	Schleichera trijuga
7.48	Salvadora oleoides	48.7	Eriobotrya japonica
7.7 - 10.7	Raphia Ruffa	49.1	Blighia sapida
8.0 - 10.0	Cocos nucifera	50.1 - 64.0	Bassia longifolia
8.79	Rhus diversiloba	50.7	Carica Papaya
9.5 - 18.5	Virola bicuhyba	50.7	Pithecoctenium echinatum
9.61- 17.0	Linum usitatissimum		
10.3 - 17.5	Elaeis guineensis	52.0	Philadelphus coronarius
10.4 - 11.2	Astrocaryum vulgare	52.31	Phoenix dactylifera
11.0 - 13.7	Attalea cohune	52.5	Polygala butyracea
11.44	Rhus laurina	52.6 - 67.85	Bassia latifolia
11.68	Lindera triloba	52.95- 59.74	Canarium polyphyllum
12.3 - 24.3	Areca catechu	53.0 - 57.44	Elaeis guineensis
12.4	Virola guatemalensis	53.9 - 66.0	Adansonia Grandidieri
13.2 - 13.5	Corypha cerifera	54.0	Dialyanthera otoba
13.8	Myristica surinamensis	54.0 - 67.2	Butyrospermum Parkii
14.0 - 20.0	Pedilanthus Pavonis	55.0	Oenocarpus distichus
15.0	Shorea aptera	55.46	Garcinia morella
15.6	Attalea funifera	56.0 - 57.2	Mimusops Djave
19.0 - 37.7	Stillingia sebifera	56.6	Pithecolobium dulce
20.53	Lindera praecox	56.8	Picramnia Lindeniana
22.6	Cannabis sativa	57.1	Canarium luzonicum
25.0 - 34.2	Garcinia indica	57.3	Buchanania latifolia
25.2	Mauritia vinifera	57.65	Paullinia trigona
26.64	Myristica canarica	58.5 - 72.1	Carapa guianensis
26.9	Acrocomia sclerocarpa	58.62- 63.4	Payena oleifera
32.3	Ulmus campestris	59.61- 61.25	Canarium pachyphyllum
32.8 - 41.7	Theobroma Cacao	60.0	Saccharum officinarum
33.42	Gossypium spp.	60.25	Melia Champaca
34.3	Palaquium oblongifolium	61.4	Chorisia Peckoltiana
		61.6	Trifolium incarnatum
35.06- 57.6	Euphorbia antisiphilitica	61.6	Lupinus albus
		61.8	Galega officinalis
36.6	Xanthophyllum lanceatum	62.3	Cyperus esculentus
		63.0	Canarium oleosum
36.6	Skaphium lanceatum	63.2 - 65.0	Bassia Mottleyana
37.82- 39.63	Vateria indica	63.9	Picramnia carpinterae

64.15	<i>Aegiphila obducta</i>	82.5 - 90.8	<i>Hydnocarpus anthelminticus</i>
64.2	<i>Symphonia globulifera</i>	83.2	<i>Lupinus angustifolius</i>
64.7 - 65.6	<i>Canarium commune</i>	83.3 -105.0	<i>Arachis hypogaea</i>
65.0	<i>Trichilia emetica</i>	83.36	<i>Coula edulis</i>
65.1	<i>Sapindus rarak</i>	83.6	<i>Betula alba</i>
65.29	<i>Lindera sericea</i>	83.61- 87.8	<i>Pistacia vera</i>
65.4	<i>Myristica angolensis</i>	83.65-179.5	<i>Couepia grandifolia</i>
65.9	<i>Trifolium hybridum</i>	83.7	<i>Carapa grandiflora</i>
66.0 - 80.5	<i>Laurus nobilis</i>	83.9 - 90.2	<i>Corylus Avellana</i>
66.0 - 96.0	<i>Hodgsonia Kadam</i>	84.0	<i>Anacardium occidentale</i>
66.08	<i>Machilus Thunbergii</i>	84.2 -100.7	<i>Joliffa africana</i>
66.5	<i>Mimusops elengi</i>	84.27	<i>Calotropis gigantea</i>
67.7	<i>Onobrychis sativa</i>	84.5	<i>Capsicum annuum</i>
68.3	<i>Lupinus luteus</i>	85.24-129.0	<i>Eriodendron anfractuosum</i>
68.5	<i>Trifolium repens</i>	85.4	<i>Dryopteris Filix-mas</i>
69.0	<i>Ornithopus sativus</i>	85.7 - 99.5	<i>Pentaclethra macrophylla</i>
69.4 - 79.3	<i>Strychnos Nux-vomica</i>	85.89- 91.2	<i>Coffea arabica</i>
69.44	<i>Ceiba pentandra</i>	86.0	<i>Calophyllum inophyllum</i>
69.6 - 72.9	<i>Melia Azadirachta</i>	86.1	<i>Canavalia ensiformis</i>
69.8 - 72.5	<i>Lophira alata</i>	86.2	<i>Garcinia tonkinensis</i>
70.0	<i>Lotus corniculatus</i>	86.7	<i>Celastrus senegalensis</i>
70.52	<i>Asclepias gigantea</i>	86.99- 87.8	<i>Olea europea var. sativa</i>
71.0	<i>Vernonia anthelmintica</i>	87.1	<i>Tamarindus indica</i>
71.1 - 74.5	<i>Secale cornutum</i>	88.0	<i>Nerium Oleander</i>
71.4	<i>Melilotus albus</i>	88.0 - 90.49	<i>Thea sasanqua</i>
71.6	<i>Anthyllis vulneraria</i>	88.3	<i>Coriandrum sativum</i>
71.64	<i>Lecythis ollaria</i>	88.5 -102.5	<i>Hydnocarpus Wightianus</i>
72.2 -112.6	<i>Moringa oleifera</i>	88.7 - 89.1	<i>Mesua ferrea</i>
73.02-101.6	<i>Strophanthus hispidus</i>	88.7 -133.4	<i>Cucurbita maxima</i>
73.4	<i>Jessenia polycarpa</i>	89.53	<i>Magnolia hypoleuca</i>
73.75	<i>Tropaeolum majus</i>	89.9	<i>Caesalpinia Bonducella</i>
74.8 - 75.7	<i>Astrocaryum vulgare</i>	89.7 - 93.3	<i>Poga oleosa</i>
75.2	<i>Limonia Warneckei</i>	89.94	<i>Hydnocarpus edulis</i>
75.9	<i>Trifolium agrarium</i>	90.0	<i>Parthenocissus quinquefolia</i>
76.14- 87.0	<i>Sterculia foetida</i>	90.0	<i>Hordeum vulgare</i>
76.4	<i>Basiloxylon brasiliensis</i>	90.4 -108.7	<i>Prunus Armeniaca</i>
76.7 - 77.8	<i>Adansonia digitata</i>	90.4 -104.4	<i>Hydnocarpus Kurzii</i>
77.28- 91.7	<i>Olea europea var. sativa</i>	90.42	<i>Thea sinensis</i>
77.3 - 94.0	<i>Pongamia glabra</i>	90.6	<i>Illicium religiosum</i>
77.9	<i>Apeiba sp.</i>	91.2 -104.0	<i>Prunus domestica</i>
78.38	<i>Akebia quinata</i>	91.6	<i>Parkia africana</i>
78.4 - 81.8	<i>Polygala Senega</i>	91.65-107.0	<i>Oryza sativa</i>
78.9	<i>Sterculia chica</i>	91.8	<i>Hedera Helix</i>
78.9	<i>Medicago sativa</i>	91.8	<i>Cuminum Cyminum</i>
80.0 - 85.0	<i>Ximenia americana</i>	92.1 - 97.68	<i>Sinapis alba</i>
80.1	<i>Petroselinum sativum</i>	92.5 -109.7	<i>Prunus Persica</i>
80.4	<i>Thea japonica</i>	92.7	<i>Crambe maritima</i>
80.78	<i>Chisocheton Cumingianus</i>	92.8 -122.6	<i>Prunus Cerasus</i>
81.0	<i>Lycopodium</i>	92.85-112.4	<i>Raphanus sativus</i>
81.4 - 90.6	<i>Ricinus communis</i>	93.0	<i>Acer Pseudo-platanus</i>
81.44-110.6	<i>Sambucus racemosa</i>	93.0 -101.26	<i>Prunus Amygdalus</i>
81.5	<i>Moquilea tomentosa</i>	93.1	<i>Illicium verum</i>
81.5 - 82.0	<i>Ungnadia speciosa</i>	93.6 -101.9	<i>Brassica oleracea</i>
81.8	<i>Terminalia Catappa</i>	94.4	<i>Dolichos Lablab</i>
81.88	<i>Secale cereale</i>	94.7	<i>Torreya californica</i>
81.9	<i>Trigonella Foenum-graecum</i>	94.8	<i>Apium graveolens</i>
82.0	<i>Vicia Faba</i>		
82.3	<i>Thea sasanqua</i>		
82.4	<i>Sterculia appendiculata</i>		

95.2	<i>Abelmoschus esculentus</i>	109.2	<i>Citrus Limonia</i>
95.2 -103.5	<i>Brassica</i> sp. (Jamba oil)	109.2	<i>Magnolia hypoleuca</i>
95.3 -104.6	<i>Brassic Napus</i>	109.5	<i>Petroselinum sativum</i>
95.4	<i>Aesculus Hippocastanum</i>	110.2	<i>Anthriscus Cerefolium</i>
95.94	<i>Argania Sideroxylon</i>	111.0	<i>Tilia americana</i>
96.1 -112.5	<i>Triticum</i> sp.	111.0	<i>Vicia sepium</i>
96.4 -100.0	<i>Brassica Rapa</i>	111.2 -120.1	<i>Fagus sylvatica</i>
97.26-104.0	<i>Citrus Aurantium</i>	111.3	<i>Phaseolus Mungo</i>
98.3 -104.9	<i>Jatropha Curcas</i>	111.8	<i>Jatropha mahajalensis</i>
98.3 -106.2	<i>Bertholletia excelsa</i>	111.8	<i>Isatis tinctoria</i>
98.6	<i>Nasturtium Nasturtium-aquaticum</i>	112.0	<i>Voandezia subterranea</i>
98.89	<i>Sorghum cernuum</i>	113.0 -113.2	<i>Datura Stramonium</i>
99.0	<i>Foeniculum officinale</i>	113.0 -120.2	<i>Cydonia vulgaris</i>
99.2	<i>Brassica campestris</i>	113.5 -126.0	<i>Sinapis nigra</i>
99.6	<i>Vicia Faba</i>	115.2 -115.6	<i>Triticum</i> sp.
99.7	<i>Oncoba echinata</i>	115.5	<i>Phalaris canariensis</i>
99.72	<i>Eruca sativa</i>	116.2	<i>Datura Metel</i>
99.8	<i>Coriandrum sativum</i>	116.5	<i>Echinocystis oregana</i>
99.8	<i>Phaseolus lunatus</i>	116.6	<i>Acanthosicyos horrida</i>
100.0	<i>Acer platanoides</i>	116.8	<i>Diospyros virginiana</i>
100.0 -101.0	<i>Cornus sanguinea</i>	117.0 -128.5	<i>Cucumis Chate</i>
100.4	<i>Lens esculenta</i>	117.1 -121.8	<i>Citrullus vulgaris</i>
100.7	<i>Quercus agrifolia</i>	117.5 -119.5	<i>Madia sativa</i>
100.8	<i>Vigna Catjang</i>	117.6 -118.5	<i>Cucumis sativus</i>
100.9 -120.5	<i>Gossypium</i> sp. (cotton)	117.6 -137.0	<i>Manihot Glaziovii</i>
101.0	<i>Manniophyton fulvum</i>	117.6 -139.3	<i>Hevea brasiliensis</i>
101.3	<i>Pinus monophylla</i>	118.3	<i>Pinus Gerardiana</i>
101.4 -121.7	<i>Brassica campestris</i>	118.5	<i>Cicer arietinum</i>
101.7 -109.0	<i>Croton Tiglium</i>	118.6	<i>Nicotiana Tabacum</i>
101.72-133.5	<i>Lepidium sativum</i>	118.6	<i>Laurus indica</i>
101.8	<i>Eruca sativa</i>	118.9	<i>Phaseolus inamoenus</i>
101.8	<i>Brassica juncea</i>	119.0	<i>Nigella sativa</i>
102.6	<i>Sinapis arvensis</i>	119.5	<i>Gynandropsis pentaphylla</i>
102.7	<i>Cajanus bicolor</i>	119.6	<i>Anethum graveolens</i>
103.0 -115.0	<i>Sesamum indicum</i>	119.7	<i>Trifolium repens</i>
103.3	<i>Sinapis chinensis</i>	119.7	<i>Omphalea megacarpa</i>
104.0	<i>Mucuna urens</i>	119.7 -130.7	<i>Cucurbita Pepo</i>
104.3	<i>Melampyrum arvense</i>	119.7 -135.0	<i>Helianthus annuus</i>
105.0	<i>Raphanus Raphanistrum</i>	119.91-122.5	<i>Argemone mexicana</i>
105.0	<i>Balanites aegyptiaca</i>	120.3	<i>Citrullus Naudinianus</i>
105.1	<i>Daucus Carota</i>	120.4 -129.3	<i>Citrullus Colocynthis</i>
105.3	<i>Pimpinella Anisum</i>	120.5	<i>Pinus Abies</i>
105.6	<i>Sinapis dissecta</i>	120.9	<i>Pinus Pineae</i>
106.0 -107.0	<i>Citrullus vulgaris</i>	120.9	<i>Pinus Piceae</i>
106.0	<i>Carya Pecan</i>	121.0	<i>Pyrus communis</i>
106.0	<i>Pisum sativum</i>	121.0 -130.8	<i>Cucurbita maxima</i>
106.3	<i>Carya ovata</i>	122.5	<i>Zea Mays</i>
106.9 -125.0	<i>Lycopersicum esculentum</i>	122.5	<i>Martynia louisiana</i>
107.2	<i>Vicia sativa</i>	123.7	<i>Citrullus vulgaris</i>
107.25	<i>Citrus Limonia</i>	123.9	<i>Tilia parvifolia</i>
107.5	<i>Myrtus communis</i>	124.0 -143.0	<i>Glycine hispida</i>
108.0	<i>Pinus monophylla</i>	124.3	<i>Trifolium pratense</i> var. perenne
108.5	<i>Caryodendron orinocense</i>	124.58	<i>Cheiranthus Cheira</i>
108.51	<i>Luffa aegyptiaca</i>	126.0	<i>Citrus aurantifolia</i>
108.6	<i>Pimpinella Anisum</i>	126.0 -129.6	<i>Cucurbita Pepo</i>
108.8	<i>Ptychotis ajowan</i>	126.1	<i>Daphne Cnidium</i>
108.9	<i>Prunus Laurocerasus</i>	126.3	<i>Celosia cristata</i>
		126.6 -133.8	<i>Guizotia abyssinica</i>
		126.9	<i>Rhus glabra</i>

127.6	<i>Lactuca scariola</i> var. oleifera	142.2	<i>Torreya nucifera</i>
128.5	<i>Sorbus Aucuparia</i>	143.3	<i>Armoracia rusticana</i>
128.5	<i>Carum Carvi</i>	143.3	<i>Morus alba</i>
128.6 -134.8	<i>Aleurites ricinodendron</i>	145.6 -160.7	<i>Stillingia sebifera</i>
128.9	<i>Caragana arborescens</i>	145.7	<i>Pinus montana</i>
129.5	<i>Fraxinus excelsior</i>	147.1	<i>Pinus sylvestris</i>
130.3	<i>Cephalotaxus drupacea</i>	147.7 -148.2	<i>Aleurites Ricinodendron</i>
130.4	<i>Setaria italica</i>	147.8	<i>Rubus fruticosus</i>
130.4 -130.7	<i>Vitis vinifera</i>	147.8	<i>Arbutus Unedo</i>
130.9	<i>Kickxia elastica</i>	148.0 -166.0	<i>Cannabis sativa</i>
131.7	<i>Cytisus Laburnum</i>	148.9	<i>Oenothera biennis</i>
131.7 -134.86	<i>Amoora Rohituka</i>	149.0 -161.3	<i>Elaeococca vernicia</i>
132.1 -151.7	<i>Juglans regia</i>	149.7 -161.5	<i>Humulus Lupulus</i>
132.6 -157.5	<i>Papaver somniferum</i>	151.6 -171.7	<i>Aleurites cordata</i>
133.3	<i>Cucumis Melo</i>	152.5	<i>Papaver somniferum</i>
133.7	<i>Amorpha fruticosa</i>	152.5	<i>Ribes rubrum</i>
134.0	<i>Spartium junceum</i>	152.8	<i>Gynocardia odorata</i>
134.0	<i>Maclura pomifera</i>	152.8	<i>Crataegus Oxyacantha</i>
135.0	<i>Pyrus Malus</i>	153.6	<i>Lappa minor</i>
135.1	<i>Cupressus sempervirens</i>	153.9	<i>Citrus aurantifolia</i>
135.1	<i>Bryonia dioica</i>	154.2	<i>Medicago sativa</i>
135.1 -142.4	<i>Myagrurn sativum</i>	154.8	<i>Thuja occidentalis</i>
135.49	<i>Carthamnus Oxyacantha</i>	154.9 -155.3	<i>Hesperis matronalis</i>
135.6	<i>Melia Azedarach</i>	155.0	<i>Rhamnus cathartica</i>
135.7	<i>Phaseolus vulgaris</i> var. albus	155.0 -164.0	<i>Aleurites moluccana</i>
137.1 -140.0	<i>Asparagus officinalis</i>	156.3	<i>Pinus Cembra</i>
137.3	<i>Barbarea praecox</i>	156.5	<i>Juglans Sieboldiana</i>
137.8	<i>Trigonella Foenum- graecum</i>	159.2	<i>Pinus Cembra</i>
138.0	<i>Hyoscyamus niger</i>	161.0	<i>Robinia Pseudoacacia</i>
138.0 -139.0	<i>Funtumia elastica</i>	162.1	<i>Lallemantia iberica</i>
138.1 -141.2	<i>Echinops ritro</i>	167.2	<i>Vaccinium Myrtillus</i>
138.5	<i>Croton Elliotianus</i>	169.2	<i>Vaccinium Vitis-idaea</i>
138.64-149.93	<i>Carthamnus tinctorius</i>	170.0 -201.0	<i>Linum usitatissimum</i>
140.0	<i>Linaria reticulata</i>	171.0	<i>Hyptis spicigera</i>
141.2	<i>Phaseolus coccineus</i>	174.8	<i>Rubus idaeus</i>
141.4	<i>Parthenocissus quinque- folia</i>	177.3 -204.0	<i>Plukenetia conophora</i>
		180.3	<i>Fragaria vesca</i>
		193.3 -195.0	<i>Perilla nankinensis</i>
		196.45	<i>Perilla frutescens</i>

OIL GROUPS

Taxaceae §

Cephalotaxus (D)

Torreya (ND)

Torreya (D)

Pinaceae *

Pinus (D)

Thuja (D)

Cupressus (D)

Gramineae §

Paniceae

Panicum (D)

Maydeae

Zea (SD)

Oryzae

Oryza (ND)

Andropogoneae

Sorghum (SD)

Phalarideae

Phalaris (SD)

Hordeae

Secale (SD)

Triticum (SD)

Hordeum (SD)

Palmae †

Phoenix (ND)

Corypha (W)

Mauritia (F)

Raphia (W, F)

Ceroxylon (W)

Klopstockia (W)

Jessenia (ND)

Euterpe (SD)

Oenocarpus (F, SD Kernel)

Areca (F)

Elaeis (F)

- Attalea (F)
 Cocos (F)
 Acrocomia (F)
 Astrocaryum (F)
 Liliaceae §
 Asparagus (D)
 Myricaceae †
 Myrica (F)
 Juglandaceae *
 Juglans (D)
 Carya (SD)
 Betulaceae *
 Corylus (ND)
 Betula (ND)
 Fagaceae *
 Fagus (SD)
 Quercus (ND)
 Ulmaceae §
 Ulmus (ND)
 Moraceae †
 Morus (D)
 Maclura (D)
 Ficus (W)
 Humulus (D)
 Cannabis (D, W)
 Olacaceae †
 Ongokea (D)
 Ximenia (ND)
 Coula (ND, F)
 Chenopodiaceae §
 Bassia (F)
 Amaranthaceae †
 Celosia (D)
 Ranunculaceae *
 Nigella (SD)
 Delphinium (SD)
 Lardizabalaceae
 Akebia (ND)
 Magnoliaceae * †
 Magnolia (SD)
 Illicium (SD)
 Myristicaceae
 Viola (F)
 Scyphocephalum (F)
 Lauraceae †
 Cinnamomum (F)
 Persea (F)
 Machilus (F)
 Tetranthera (F)
 Lepiadenia (F)
 Litsea (F)
 Lindera (ND)
 Laurus (F, SD)
 Papaveraceae *
 Chelidonium (SD)
- Argemone (D)
 Papaver (W, D)
 Cruciferae *
 Barbarea (SD)
 Nasturtium (SD)
 Cheiranthus (D)
 Armoracia (SD)
 Hesperis (D)
 Eruca (SD)
 Sinapis (SD)
 Brassica (SD)
 Lepidium (SD)
 Myagrum (D)
 Isatis (SD)
 Crambe (SD)
 Raphanus (SD)
 Capparidaceae † †
 Gynandropsis (SD)
 Resedaceae †
 Reseda (D)
 Moringaceae †
 Moringa (ND)
 Saxifragaceae *
 Philadelphus (W)
 Ribes (D)
 Rosaceae *
 Chrysobalanaceae
 Moquilea (ND)
 Couepia (D)
 Pruneeae
 Prunus (ND)
 Rubeae
 Rubus (D)
 Potentilleae
 Fragaria (D)
 Pomeae
 Cydonia (ND)
 Sorbus (D)
 Pyrus (SD)
 Eriobotrya (F)
 Crataegus (D)
 Leguminosae §
 Ingeae
 Pithecolobium (F)
 Mimoseae
 Parkia (F)
 Pentaclethra (ND)
 Amherstieae
 Tamarindus (SD)
 Caesalpinieae
 Caesalpinia (SD)
 Genisteae
 Lupinus (ND)
 Spartium (SD)
 Trifolieae
 Trigonella (ND)
 Medicago (D, ND)

- Melilotus (ND)
 Trifolium (ND, SD)
 Ornithopus (ND)
 Loteae
 Anthyllis (ND)
 Lotus (ND)
 Galegeae
 Amorpha (D)
 Galega (ND)
 Robinia (D)
 Caragana (D)
 Hedysareae
 Onobrychis (ND)
 Arachis (ND)
 Dalbergieae
 Pongamia (F)
 Dipteryx (F)
 Viciaeae
 Cicer (SD)
 Lens (SD)
 Vicia (SD)
 Pisum (SD)
 Phaseoleae
 Cajanus (SD)
 Glycine (D)
 Canavalia (SD)
 Mucuna (SD)
 Phaseolus (SD)
 Voandzeia (SD)
 Vigna (SD)
 Dolichos (SD)
 Tropaeolaceae
 Tropaeolum (ND)
 Linaceae
 Linum (D, W)
 Zygophyllaceae † ‡
 Balanites (SD)
 Rutaceae †
 Limonia (F)
 Citrus (SD)
 Simarubaceae †
 Simaruba (F)
 Brucea (ND)
 Irvingia (F)
 Picramnia (F)
 Burseraceae †
 Canarium (ND, F)
 Meliaceae †
 Melieae
 Melia (F, D)
 Trichilieae
 Chisocheton (ND)
 Amoora (D)
 Carapa (F)
 Trichilia (F)
 Polygalaceae §
 Polygala (ND, F)
- Xanthophyllum (F)
 Skaphium (F)
 Euphorbiaceae †
 Plukenetia (D)
 Euphorbia (W)
 Pedilanthus (W)
 Croton (SD, D)
 Manniophyton (SD)
 Caryodendron (SD)
 Ricinus (ND)
 Aleurites (D)
 Elaeococca (D)
 Jatropha (SD)
 Hevea (D)
 Manihot (D)
 Omphalea (SD)
 Stillingia (D, F, seed coat)
 Anacardiaceae †
 Anacardium (ND)
 Buchanania (F)
 Pistacia (ND)
 Rhus (F, SD, seed kernel)
 Celastraceae *
 Euonymus (SD)
 Celastrus (ND)
 Aceraceae *
 Acer (D?)
 Hippocastanaceae
 Aesculus (ND)
 Sapindaceae †
 Paullinia (F)
 Allophylus (F)
 Sapindus (ND)
 Schleichera (F)
 Nephelium (F)
 Blighia (F)
 Ungnadia (ND)
 Rhamnaceae §
 Rhamnus (D)
 Vitaceae †
 Vitis (ND)
 Parthenocissus (SD)
 Tiliaceae †
 Apeiba (ND)
 Tilia (SD)
 Malvaceae †
 Abelmoschus (SD)
 Gossypium (W, SD)
 Bombacaceae †
 Adansonia (F)
 Eriodendron (SD, W)
 Sterculiaceae †
 Theobroma (F)
 Sterculia (ND)
 Basilloxylon (F)
 Ochnaceae †
 Lophira (F)

- Caryocaraceae
 Caryocar (F)
- Dipterocarpaceae ‡
 Shorea (F)
 Vateria (F)
- Theaceae † ‡
 Thea (ND)
- Guttiferae †
 Moronebeae
 Symphonia (F)
 Pentadesma (F)
 Cariniceae
 Garcinia (F)
 Calophylleae
 Calophyllum (ND)
 Mesua (ND)
- Flacourtiaceae †
 Oncoba (F)
 Hydnocarpus (F)
 Gynocardia (D)
- Caricaceae † ‡
 Carica (F)
- Combretaceae †
 Terminalia (ND)
- Thymelaeaceae §
 Daphne (SD)
- Myrtaceae †
 Myrtus (SD)
- Lecythidaceae †
 Bertholletia (SD)
 Lecythis (ND)
- Rhizophoraceae †
 Poga (ND)
- Onagraceae *
 Oenothera (D)
- Araliaceae † *
 Hedera (ND)
- Umbelliferae *
 Anthriscus (SD)
 Cuminum (SD)
 Apium (SD)
 Petroselinum (SD)
 Pimpinella (SD)
 Anethum (SD)
- Cornaceae *
 Cornus (ND)
- Ericaceae *
 Arbutus (D)
 Vaccinium (D)
- Sapotaceae †
 Payena (F)
 Mimusops (F)
 Palaquium (F)
- Araganum (ND)
 Mimusops (F)
- Ebenaceae † ‡
 Diospyros (SD)
- Oleaceae * †
 Fraxinus (SD)
 Olea (ND)
- Salvadoraceae
 Salvadora (F)
- Loganiaceae †
 Strychnos (F)
- Apocynaceae †
 Kickxia (D)
 Funtumia (D)
 Nerium (ND)
 Strophanthus (ND)
- Asclepiadaceae †
 Asclepias (W)
 Calotropis
 Cynanchum (W)
- Verbenaceae †
 Aegiphila (F)
- Labiatae *
 Lallemantia (D)
 Perilla (D)
 Hyptis (D)
- Solanaceae †
 Hyoscyamus (D)
 Capsicum (SD)
 Lycopersicum (SD)
 Datura (SD)
 Nicotiana (SD)
- Scrophulariaceae §
 Linaria (D)
 Melampyrum (ND)
- Bignoniaceae †
 Pithecoctenium (F)
- Pedaliaceae † ‡
 Sesamum (SD)
- Martyniaceae †
 Martynia (SD)
- Rubiaceae †
 Coffea (ND)
- Caprifoliaceae †
 Sambucus (ND)
- Cucurbitaceae †
 Hodgsonia (F)
 Telfairia (ND)
 Acanthosicyos (SD)
 Luffa (SD, F)
 Bryonia (SD)
 Citrullus (SD)
 Cucumis (SD)

68 FIELD MUSEUM OF NATURAL HISTORY—BOTANY, VOL. IX

Cucurbita (SD)	Madia (D)
Echinocystis (SD)	Echinops (D)
Compositae §	Lappa (D)
Vernonia (ND)	Carthamnus (D)
Helianthus (D)	Mogumia (W)
Guizotia (D)	Lactuca (SD)

* Temperate † Subtropical ‡ Tropical § Widely distributed

D=Drying SD=Semi-drying ND=Non-drying F=Fat W=Wax

BOTANICAL SERIES

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USEFUL PLANTS AND DRUGS OF
IRAN AND IRAQ

BY

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WELLCOME HISTORICAL MEDICAL MUSEUM, LONDON

WITH NOTES BY

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CONTENTS

	PAGE
I. Preface	73
II. Introduction	75
III. Descriptions	79
IV. Some prescriptions from Isfahan, Iran	200
V. Alphabetical list of native names with Latin equivalents .	217

PREFACE

During 1934 as leader of the Field Museum Anthropological Expedition to the Near East, in addition to about 10,000 herbarium specimens from Trans-Jordan, Palestine, Syria, Iraq, and Iran, I collected a number of useful plants and drugs in Iran and Iraq.

The late Dr. Berthold Laufer, then Curator of Anthropology, had requested me to make this collection and to obtain such information as could be had regarding their use in the treatment of diseases and in prescriptions for various ailments.

In Iran specimens were purchased in the native markets of Tehran and Isfahan. In each case the Persian name with its English transliteration and the use of the drug or herb was recorded. While guests of Dr. Erich Schmidt at Rayy during September, 1934, we obtained specimens in Tehran. Dr. Walter P. Kennedy of the Royal College of Medicine in Baghdad and Mr. George Miles, member of the archaeological expedition staff at Rayy, assisted in this work.

At Isfahan Mirza Muhammad Ali Khan, ninety-five-year-old doctor, very kindly consented to dictate his prescriptions (pp. 200-216) for various ailments. He began to practice medicine at the age of twenty after spending about five years in a local school. His father, several uncles, and his grandfather were medical practitioners using the oral tradition and two large handwritten volumes of prescriptions, which I examined at his home in the depths of the labyrinthine Ghetto. At Isfahan the dictation in Persian was recorded by Juda Rabbi Hedvat of the Alliance Israélite.

The translation was prepared in part by Dr. A. H. Mookree and by Dr. A. H. K. Sassani, Iran Government scholar at the University of Chicago. Dr. H. W. Bailey of the School of Oriental Studies, University of London, revised the Persian characters and the transliterations.

The assistance of Mr. Paul C. Standley, Associate Curator of Botany in Field Museum, who checked the botanical names in the text, and of Miss Elizabeth Reniff in the preparation of the report is gratefully acknowledged.

Mr. A. R. Horwood of Kew Herbarium very kindly identified some of the specimens.

The spelling of place names conforms to the system adopted by the British Permanent Committee on Geographical Names, published in London by the Royal Geographical Society.

To conform to current practice Iran has been substituted for Persia and Irani for Persian except in historical references.

In Iraq Dr. Hydari, Director of the Rustam Agricultural Experimental Farm at Hinaiidi near Baghdad, presented to Field Museum a number of varieties of *Gossypium*, *Hordeum*, and *Triticum*. Dr. Calvin K. Staudt, Director of the American School for Boys in Baghdad, contributed information regarding local drugs.

As a result of Dr. Laufer's death, arrangements had to be made for the study and publication of the material desired by him without the benefit of his collaboration. Other collections of drugs from southwestern Asia had been studied by Dr. David Hooper of the Wellcome Historical Medical Museum in London. I therefore visited him to discuss the question of the identification of the collections from Iran and Iraq. Dr. Hooper, who a few years previously had published an account of the drugs of Iran, consented to prepare a report on the Field Museum material and this publication is the result. To his account, I have in certain cases added some notes (H.F.) and, from sources indicated in each instance, mostly from Evan Guest, a mention of some of the more important useful plants not a part of the collection studied by Dr. Hooper. Dr. Casey A. Wood has published a translation of the "Tadhkirat" of Ali ibn Isa of Baghdad (circa A.D. 940-1010) under the title "Memorandum Book of a Tenth-Century Oculist," Chicago, 1936. This publication contains (pp. 47-78) a list of drugs and other remedial agents which can be compared with the data in this report.

Because of the difficulties involved in recording the colloquial names for the various plants and drugs and their transliterations, there are inevitably certain discrepancies, but I believe that the list of native names in alphabetical order with their Latin equivalents should be of value to other collectors. If the native name is not in the list, the reader should refer to tukhm (seeds), gul-i (flowers), gil-i (earth), or rishah (root), as the name may appear in these forms.

The useful plants and materia medica of southwestern Asia may be considered to be fairly well known and no new drug plants are included in the list, but it is hoped that this report will be of value in making existing information even more accessible and in encouraging medical officers to publish additional information.

The rapid advance of westernization in Iran under Reza Shah Pahlevi and in Iraq under King Ghazi necessitates the accurate recording of rapidly disappearing primitive medical folklore.

USEFUL PLANTS AND DRUGS OF IRAN AND IRAQ

DAVID HOOPER

INTRODUCTION

The material embodied in the present catalogue is the result of three collections made in Iran and Iraq during the past eight years. The first was made by Henry Field, leader of the Field Museum Anthropological Expedition to the Near East, 1934. These specimens were obtained mostly from the bazaars of Tehran, Isfahan, and Baghdad, while some were gathered in fields and gardens where medicinal plants were cultivated. Lists accompanied these plants, stating their vernacular names and local properties and uses. The second collection was made in 1933 by Captain P. Johnston-Saint, of the Wellcome Historical Medical Museum in London; this consisted of 200 vegetable, animal, and mineral medicines from the markets of Putrus and Tehran.

The third collection was made by Dr. J. M. Cowan and Dr. C. D. Darlington in the spring of 1929 (*Kew Bulletin*, 1930, pp. 49-68). The drugs were all of vegetable origin and were found in the bazaars of Tehran, Hamadan, and Kermanshah.

The specimens of the first-named collection are specified in the catalogue under the name of "Field" followed by the number of the drug in the list. The numbers in the Field collection not followed by place names are from Tehran. Those followed by the letter A were obtained in Baghdad, Iraq. The specimens in the second collection are marked by "W.H.M.M." (Wellcome Historical Medical Museum) followed by the registered number. Those collected by Cowan and Darlington are distinguished by the letters "K.B." followed by a number referring to the page in the *Bulletin of Miscellaneous Information*, No. 6, Royal Botanic Gardens, Kew, 1931, pp. 299-344, where the drug is described.

An opportunity is thus given of studying crude drugs and comparing them with the names of those found in the ancient literature of Iran where materia medica has long been a special science. One of the first and most important of the Persian works on pharmacology is the "Kitabulabnyat an haqa 'iq-uladvayat," or "Book of the Foundations of the True Properties of the Remedies," written about A.D. 970 by the physician Abu Mansur, who during one of his journeys

visited India. B. Laufer ("Sino-Iranica," 1919) says, "This is not only the earliest Persian work on the subject but the oldest production in prose of the Neo-Persian literature. The text has been examined by R. Seligmann from a unique manuscript of Vienna dated 1055, the oldest extant Persian manuscript." There is a translation by Abdul-Chaliq Achundow from Baku. This has been rendered into German and published by Dr. R. Kobert in his "Historische: Die pharmacologischen Grundsätze des Abu Mansur Muwaffak, 1893." References to this work are noted under the name "Achundow."

In the year 1681 there was published in Paris the "*Pharmacopoeia Persica, ex idiomate Persico in Latinum conversa, opus missionariis, mercatoribus, caeterisque Regionum Orientalium, Lustratoribus necessarium nec non Europaeis Nationibus perutile.*" This was written by a Carmelite monk, Frater Angelus. There is a short list of a few raw drugs, but the work contains chiefly prescriptions for pharmaceutical preparations, many of which are made up of fifteen to twenty ingredients.

A valuable work of more recent date is one published in Tehran in 1874. It was compiled by Professor J. L. Schlimmer, of the Polytechnic College of Persia, Chief Medical Officer to the Persian Army, and Sanitary Officer, Tehran. It is written in French, and entitled "*Terminologie Médico-Pharmaceutique et Anthropologique Française-Persane.*" This contains a very full list of medicinal plants of Iran with identifications made by Boissier, de Candolle, Haussknecht, and other eminent European pharmacologists and botanists.

Dr. J. E. T. Aitchison has botanically explored portions of Iran and the neighboring regions, and his "Notes on the Products of Western Afghanistan and of North-Eastern Persia," published in Edinburgh in 1890, has been most useful for reference. Dr. William Dymock, for many years Medical Storekeeper for Bombay, had exceptional opportunities of studying the drugs coming into India from the Persian Gulf, and his great knowledge of Oriental languages, in addition to his medical and botanical training, placed him in the front rank of Indian pharmacognosists. His "*Vegetable Materia Medica of Western India*" (1885) and, later, his "*Pharmacographia Indica*" are storehouses of information on the trade, natural history, and composition of Oriental drugs. Use has also been made of the "*Flora of Syria, Palestine and Sinai*" by the Reverend G. E. Post (1896), Boissier's "*Flora Orientalis*," and "*A Working List of the Flowering Plants of Baluchistan*," by Mr. I. H. Burkill (1909).

Many useful notes on drugs and Persian and Turki names of North Persian plants occur in a series of articles by B. Gilliat-Smith and W. B. Turrill in *K.B.* 1930, Nos. 7-10, entitled "On the Flora of the Nearer East: A Contribution to Our Knowledge of the Flora of Azerbaidjan, North Persia."

ABBREVIATIONS AND PUBLICATION REFERENCES

- Abu Mansur*—"Book of the Foundations of the True Properties of the Remedies" (970).
Achundow—Translation of Abu Mansur's work, rendered into German by R. Kobert (1893).
Acosta, Christobal, of Burgundy—Traveler in the East; d. 1580.
Afg.—Afghanistan.
Ait.—Aitchison, J. E. T. "Notes on the Products of Western Afghanistan and N. E. Persia," Edinburgh (1890).
Amoen. Exot.—1712; see Kämpfer.
Ar.—Arabic.
Bagh.—Baghdad.
Bal.—Baluchistan.
Bellew—"From the Indus to the Tigris," London (1874).
Beng.—Bengal.
Boiss.—Boissier. "Flora Orientalis," Geneva (1867-84).
Bom.—Bombay.
B. P.—"British Pharmacopoeia" (1914).
Brissemoret, A.—Chemical investigator (1907-26).
C.—See Cowan.
Chin.—Chinese.
Colloquios—Orta, Garcia da, edited by Sir Clements Markham (1913).
Connold—"British Oak Galls" (1922).
Cowan—Cowan, J. M. Collected plants in Persia (1929).
Duk.—Dukani, language of the Deccan, India.
Dymock—Dymock, William. "Vegetable Materia Medica of Western India" (1885); "Pharmacographia Indica" (1891).
Ebert—Ebert, A. E. (1840-1906). American pharmacist.
Egy.—Egypt.
Field—Field collection in Field Museum of Natural History.
Fl. Br. Ind.—"Flora of British India" (1875-98).
Fr.—French.
G.—See Guest.
Gilliat-Smith—Gilliat-Smith, B. and Turrill, W. B. "On the Flora of the Nearer East," *K. B.* 1930, Nos. 7-10.
Gr.—Greek.
Guest—Guest, Evan. "Plants and Plant Products of Iraq" (1933).
Guz.—Guzerati.
Ham.—Hamadan.
Hind.—Hindustani.
Honigberger—Honigberger, J. M. "Thirty-five Years in the East," London (1852).
Houard—Houard, C. "Les Zoécécides des Plantes d'Afrique, d'Asie et d'Océanie" (1923).
Hughes-Buller—Collected plants in Baluchistan (1908).
Ibn Baitar—Great Arabian traveler and botanist (1197-1248).

I. H. B.—Burkill, I. H. "A Working List of the Flowering Plants of Baluchistan" (1909).

Ind.—India.

Ind. bazaars—Indian bazaars.

Irvine, W.—"Materia Medica of Patna" (1848).

Isf.—Isfahan.

Kämpfer—"Amoenitates Exoticae, Lemgoviae" (1712).

Kash.—Kashmiri.

K. B. or Kew Bull.—Kew Bulletin.

Kerm.—Kermanshah.

Khory—Khory and Katrak. "Materia Medica of India," Bombay (1903).

Kobert—Kobert, R. "Composition and Uses of Saponin" (1911).

Kurd.—Kurdish.

Lat.—Latin.

Laufer—"Sino-Iranica" (1919).

Layard—Layard, Henry. "Early Adventures in Persia" (1853).

Le Bode—Le Bode, C. A. "Travels in Lauristan and Arabistan."

Leh—Aitchison. "Trade Products of Leh" (1874).

Mad.—Madras.

Makhjan-el-Adwiya.—1769, reprinted 1824.

Mal.—Malayali (South India).

Mason—"Burma and Its People" (1882).

Modern Gr.—Modern Greek.

Pers.—Persian.

Pharmacog.—"Pharmacographia," by Fluckiger and Hanbury (1874).

Pharm. Journ.—"Pharmaceutical Journal."

Ph. Ind.—"Pharmacographia Indica" (1891).

Ph. Pers.—"Pharmacopoeia Persica" (1681).

Port.—Portuguese.

Post—Post, G. E. "Flora of Syria, Palestine and Sinai" (1896).

Punj.—Punjab.

Razis or Rhazes—Islamic physician (850–923). "Continens."

Royle—Royle, J. R. "Illustrations of Himalayan Botany" (1839).

Sans.—Sanskrit.

Schl.—Schlimmer, J. L. "Terminologie Médico-Pharmaceutique et Anthropologique Française-Persane" (1874).

Sci. Pa.—Hanbury, D. "Science Papers" (1876).

Sino-Iranica—See Laufer.

Stapf—Stapf, Otto (1857–1933). Botanical papers in Kew Bulletin, etc.

Sud.—Sudanese.

Syr.—Syrian.

Tab.—Tabriz.

Tam.—Tamil.

Teh.—Tehran.

Tri.—Tripoli.

Tschirsch—Tschirsch, A. "Handbuch der Pharmakognosie" (1912).

Turk.—Turki.

Warden—Warden, C. J. H. Calcutta (1851–1901), joint editor of "Pharmacographia Indica."

Wiesner—"Die Rohstoffe des Pflanzenreiches," ed. 4 (1927).

W.H.M.M.—Collection in Wellcome Historical Medical Museum, London.

Yark.—Yarkand.

Y. B. Pharm.—"Year Book of Pharmacy."

Zellner—Zellner, J. Phytochemical investigator (1923–27).

Abrus precatorius L. (Leguminosae)

چشم خروس

Chashm-i-khurūs (Pers.); Rati (Hind.); Jequirity (Tupi, Brazil); Paternoster seed, Indian licorice.

Schl.; Fl. Br. Ind. 2: 175; Ph. Ind. 1: 430.

W.H.M.M. 150736; K.B. 301.

This plant is cosmopolitan in the tropics and grows in India. The well-known scarlet seeds, with a black spot at one end, are exported from India to Iran and other countries in the West, and are made into necklaces and rosaries. They were formerly used in India as a standard weight by goldsmiths, the average weight of a seed being 1.7 grams.

In medicine the seeds are said to have hilarant properties, and in Iran they are classified among the poisons. The seeds contain toxalbumin, a protein body. The leaves and root contain sugars (D. Hooper, *Pharm. Journ.* 1894, 937).

Acacia Senegal Willd. (Leguminosae)

صمغ ارژن

Samgh-i-arzhan, Angūm (Teh.); Samgh Arabi (Ar., Pers., Iraq); gum arabic.

Field 78A, 257; 30, 70 (Iraq); W.H.M.M. 150716.

Acacia Senegal is the chief source of gum arabic of commerce, but in the Eastern bazaars many gums are sold which are procured from various other trees. Schlimmer in his "Terminologie" speaks of Gummi nostras or indigenous gum obtained from cherry and prune trees.

Acanthophyllum squarrosum Boiss. (Caryophyllaceae)

شیر کلن

Shir Kalan (Teh.); the root.

W.H.M.M. 150848.

This is one of the Irani soap-roots. It is smaller than the usual roots supplied by species of Gypsophylla, as it occurs in pieces 3 to 18 mm. in diameter, has an exterior of light brown, twisted spirally, with a white, starchy interior showing yellowish, woody rays. The root has a slightly bitter taste and contains small quantities of saponin.

Achillea Santolina L. (Compositae)

کل بومادران

Gul-i-būmādarān (Teh.); Bui madaran (Punj.); Birinjasaf (Ind. bazaars); yarrow.

Ait.; I.H.B.; Schl.; Boiss. 2: 266; Ph. Ind. 2: 272.

Field 236; W.H.M.M. 150802; K.B. 302.

This plant is widely distributed in the East and in northern Africa, where the flowering tops, with a pleasant aroma, are collected and used as a carminative and tonic. In Tehran they are given as an infusion for chest complaints. In Baluchistan the drug is given to children for colic. The strong odor of the herb, like that of other composites, drives away fleas and noxious insects.

Acorus Calamus L. (Araceae)

اکسیر ترکی

Aksīr-i-turkī, Ajil-i-turkī (Teh.); Ighir iggur (Ar.); Acoron (Gr.); Gora vach (Hind.); Bach, Warch, trade names in Leh by Punjabis; calamus or sweet flag root.

Field 174; W.H.M.M. 150826.

A native of eastern Europe and Central Asia this has become widely diffused by cultivation. The rhizome has long been esteemed as a valuable medicine in India and Iran, whence probably its use spread to Europe. It is a bitter aromatic stimulant, tonic, and carminative. In Tehran it is reputed to be an excellent remedy for rheumatism. On account of its aroma the powdered root is regarded as an insectifuge and insecticide, and the volatile oil is used for scenting snuff and for the preparation of aromatic vinegar.

Adansonia digitata Juss. (Bombacaceae)

ففتہ

Fūtfūteh (Teh.).

W.H.M.M. 150744.

The baobab or cream of tartar tree is a native of tropical Africa introduced into the East Indies. The substance sent under the name of Fūtfūteh is in lumps of brownish vegetable matter consisting of the fibrous pulp surrounding the seeds inside the gourd-like fruit. The fresh pulp is acid and astringent and is given in cases of diarrhea and dysentery.

Adiantum Capillus-Veneris L. (Polypodiaceae)

پر سیاوش

Parr-i-siyāvash, Kashburat (Teh.); Kashburat-el-bir, "coriander of the wall" (Pers.); Krafas-al-bir, Shar-al-anat (Iraq); Kansburaj, Moohar-khas (Ind. bazaars); the fronds.

Ait.; Post; Schl.; Ph. Ind. 3: 624.

Field 49; W.H.M.M. 150714; K.B. 302.

The maidenhair fern is found in Iran, Afghanistan, the north-western Himalayas, and western China, but other species of ferns are used medicinally and are called by similar names. The fronds of the fern are usually supplied, but the rhizome is credited with expectorant properties and is given for relieving difficult respiration and for spasms in whooping cough.

—A maidenhair fern decoction is served as a cooling drink during the summer (H.F.).

Agaric (Fungi)

قارچ

Qārch (Teh.); Kriwarik (Turk.); dried mushrooms.

Field 242; W.H.M.M. 150775.

This is a portion of a hard fungus, gray brown on the outside and whitish within, 4 to 5 inches across. A notation is made on one sample that it is a vermifuge. Schlimmer identifies "Ghartsche" as *Agaricus esculentus*, one of the edible mushrooms, of which there are numerous species. For agaricum of the Greeks, Ghariqun, see *Polyporus officinalis*.

Alhagi camelorum Fisch. (Leguminosae)

Tar-anjubin (Teh.); "green honey"; manna.

Field 1; W.H.M.M. 150888.

The camel's thorn (Kār shūtūr, Pers.) is a thorny shrub found in the deserts of Iran, Syria, and Egypt. A saccharine exudation forms on the plant. It is shaken off the branches, collected, and used as a sweetmeat and in medicine. It is supposed to be the "greenish cake" of Layard's "Travels," but this secretion was collected from oak trees (see *Quercus*). The white grains of manna separated from the pods, stalks, and leaves contain chiefly cane sugar; this is administered as a laxative and expectorant.

Allium Akaka Gmel. (Liliaceae)

والک

Vālik (Teh.); the plant.

W.H.M.M. 150838.

This plant is found in Europe and northern Asia, and is the Welec or Weleque of Ehlicher. The specimen is represented by the entire plant: leaves, pinkish green flowers, and bulbs, having a strong alliaceous odor.

Allium Cepa L. (Liliaceae)

تخم پیاز

Tukhm-i-piyāz (Teh.); Basal (Ar.); Goondina (Pers.); Piaz (Kurd.); the seeds.

Field 41, 415; W.H.M.M. 150831.

The onion is probably the earliest kind of food plant and is widely cultivated in tropical, subtropical, and temperate countries. Its small, black, corrugated seeds are sold in all the bazaars of Iran and are regarded as a demulcent and stimulant.—Boiled with sugar and almond oil they are given as a purgative during typhoid fever (H.F.).

Allium sativum L. (Liliaceae)

تخم تره

Tukhm-i-tarrah (Teh.); (tarrah is the Persian name for potherb); the seeds.

Boiss. 5: 229.

Field 40; W.H.M.M. 150883; K.B. 302.

Under this name the black, angular seeds of garlic are sold in the bazaars, having similar properties to those of the onion. They are eaten with cheese.

Sir (Teh., Iraq); Som (Ar.); Thum (Turk.); Lehshan (Hind.); garlic.

Field 47A, 77, 115 (Iraq).

This is the bulb of the garlic, containing several daughter bulbs or cloves. They have a peculiarly pungent and disagreeable odor and an acrid and burning taste. The garlic is *par excellence* the potherb of the East, aids digestion, and is a gastric stimulant. Three kinds of the plant are grown in Iran: Bustani (garden), Bari (wild), and Kirathi (leek-like).

Aloe Perryi Baker (Liliaceae)

صبر زرد

Sabr-i-zard (Teh.); Sibar, Musabbar (Ar.); Bol shiah (Hind.); bitter aloes.

W.H.M.M. 150786.

This specimen is a piece of Socotrine aloes prepared from the leaves of the plant. It is a black or liverish colored extract with a brownish yellow dust. Aloes is a well-known purgative, introduced by Arab traders in early times.

Althaea lavateraefolia DC. (Malvaceae)

ریشه خطمی

Rishah-i-khatmī (Ham.); the root.

Achundow; Schl.; Boiss. 1: 828; Post; Ait.; I.H.B.

K.B. 303.

This plant grows in Egypt, Iran, and Afghanistan. Aitchison says it is cultivated not only for the showiness of its flowers but for its petals, which are collected as they fall off the plant and are called Gul-i-khatmī, the seeds Tukhm-i-khatmī. The root from Hamadan agrees with that of the above-named species. In Baghdad the roots (Erok Chatma) are said to belong to the hollyhock (*Althaea rosea* L.), but Achundow refers the drug to *A. ficifolia* Cav. The root is fibrous, light-colored, and becomes mucilaginous when soaked in water. It is considered strengthening, and is probably an Irani substitute for the root of the marshmallow of Europe (*Althaea officinalis* L.).

Althaea sp. (Malvaceae)

گل خطمی

Gul-i-khatmī (Teh.); the flowers.

Field 20; W.H.M.M. 150828.

Tukhm-i-khatmī (Isf.); the carpels.

Field 401, 35 (Iraq).

These drugs are doubtless derived from more than one species of *Althaea*. The hollyhock (*A. rosea* L.), *A. ficifolia* Cav., and *A. lavateraefolia* DC., and various hybrids yield medicinal flowers and seeds. In Baluchistan the flowers of *A. pallida* Wald. & Kit. are collected. They are yellow and pink, with hairy calyces. The seeds, or properly carpels, are brown, reniform, and hairy; the margin is marked with fan-like ridges. All parts of these plants are mucilag-

inous and demulcent.—The flowers, often mixed with linseed and boiled, are made into poultices for boils, and the seeds or carpels are given as a tea for coughs and inflammation of the chest (H.F.).

Alyssum campestre L. (Cruciferae)

فندامه شهری

Gudāmah, Gudāmah-i-shahri, Gudāmah-i-shērazi (Teh.); Qudmah (Ar.); Ghodaoumche chirazi (Schl.); hedge garlic, the seeds.

Field 3; W.H.M.M. 150727, 150868; K.B. 303.

The seeds of this small plant, common in Iran and Iraq, are light brown, lens-shaped, 2 by 1.5 mm., with a yellowish gray border. They become coated with semi-opaque mucilage when placed in water.—Mixed with *Lallemantia Royleana* Benth., *Pyrus Cydonia* L., and *Plantago major* L., the seeds are given in an infusion for coughs (H.F.).

Amaranthus paniculatus L. (Amarantaceae)

تاج خروس

Tāj-i-khurūs (Teh.); Tukhm-tāj-i-khurūs (Isf.); flower heads and seeds of cockscomb or star flower.

Field 92, 425; W.H.M.M. 150874.

The chaffy flower heads are white with shades of pink or light brown. The black, shining, lens-shaped seeds are eaten, and are medicinal. Cockscomb leaves form a wholesome potherb, and are taken as a tea to relieve the chest.

Amomum subulatum Roxb. (Zingiberaceae)

هل قراب

Hil-i-qurāb (Teh., Isf.); Hil (Ar.); Ela (Sans.); hill or Nepal cardamoms.

Field 421; W.H.M.M. 150729.

The capsules are ovate and bluntly triangular, containing numerous round or angular brown seeds, closely packed. The odor of the seeds is camphoraceous and agreeable. Hill cardamoms are used as a substitute for the smaller and more aromatic Malabar cardamoms of southern India (*Elettaria Cardamomum* Maton). They are both used as a spice and for their carminative and stimulating properties.

—As a cure for general debility they are sometimes mixed with Belleric myrobalans (H.F.).

Anacyclus Pyrethrum DC. (Compositae)

عاقِر قَرها

Agirgarhā (Teh., Isf.); Akalkara (Hind.); pellitory of Spain; the root.

Field 410; W.H.M.M. 150791.

Pellitory root, obtained in northern Africa, is nearly cylindrical in shape, tapering near the tip, with a tuft of hairs or the remains of leaves toward the crown. When chewed the drug has a pungent taste, exciting a flow of saliva.—It is prescribed for toothache (H.F.).

Anamirta paniculata Coleb. (Menispermaceae)

مَرک ماهی

Marg-i-māhī, "fish poison" (Teh.); Zahar (Iraq); the berries.

Field 138, 101 (Iraq); W.H.M.M. 150746.

Cocculus indicus or Levant berries are yielded by a shrub indigenous to eastern India and the Malay Archipelago. The fruits are round or kidney-shaped, dark brown without, each containing a white seed with oily, bitter endosperm. The power possessed by the fruits, when thrown into water, of stupefying fish has long been known, and is due to the poisonous crystalline principle, picrotoxin, in the seed. The berries are used in the East for poisoning dogs and fish and for making ointments to destroy pediculi on the skin.

Anthemis Wiedemanniana Fisch. & Mey. (Compositae)

کَل بابونه

Gul-i-bābūna (Ham.); flower heads.

Achundow; Ait.; Post; Schl.; Boiss. 2: 286; Pharmacog. 346; Ph. Ind. 2: 275; I.H.B.

K.B. 303.

Banoi is probably a contraction of Bābūna or Babunaj, a name for camomile and other medicinal composites, including the above.

Irani camomile flowers are generally obtained from *Matricaria Chamomilla* L. (q.v.).

Apium graveolens L. (Umbelliferae)

تَخَم کَرفس

Tukhm-i-karafs (Teh.); Buzz-ul-karaphs (Ar.); Asil-a-krasb (Afg.); Karafs (Iraq); Ajmud (Hind.); Udasaliyun (Gr.); wild celery fruits.

Field 177; W.H.M.M. 150808.

Celery is a plant of the northwestern Himalayas and Iran, and is cultivated for its fruit, leaf stalks, and roots. The seeds, or properly fruits, are greenish yellow or brown, and have a mint-like aroma and a somewhat pungent and bitter taste. The fruit is carminative, aromatic, and tonic. In Tehran the drug is placed in boiling water and the steam inhaled for headache. The fruits contain apūn, a jelly-like glucoside.

Arctium Lappa L. (Compositae)

ریشه بابا آدم

Rīshah-i-bābā-Adam (Teh.); the root. Bardane (Teh.); Semen Bardanae (English Herbal 1730); the fruits.

Field 234; K.B. 304.

The burdock plant is found in Syria, Iran, and Khorasan as well as in Europe. The root under the name of Risha Baba Adam or "Root of Father Adam" is quoted in Schlimmer's "Terminologie," and is regarded throughout India as depurative and antiphlogistic. In Tehran the root, with that of sarsaparilla, is used as a remedy for syphilis. The drug has had a considerable reputation in ancient times, but from a chemical examination by Zellner (1924) there is no indication of any substance in the root being physiologically active.

Areca Catechu L. (Palmae)

فوفل

Fūfal (Teh., Ar.); Papal (Pers.); Sopari (Hind.); Pinang (Mal.); betel nuts, nuts of the Areca palm.

Field 149.

Areca nuts are used everywhere in the East as a masticatory. They are a gentle stimulant, astringent, and taenifuge, increase the flow of saliva, lessen perspiration, sweeten the breath, and strengthen the gums. They contain tannin and two active alkaloids, arecoline and arecaine.—Mixed with sugar and coriander, they are given for induction of labor (H.F.).

Aristolochia longa L. (Aristolochiaceae)

زراوند طویل

Zarāvand-i-tavīl (Ham., Teh.); the roots.

Achundow; Schl.; Ph. Pers.; Post; Ph. Ind. 3: 165.

W.H.M.M. 150855; K.B. 304.

The roots of this and other species of birthwort are highly valued medicines in the East. The drug from Iran is a cylindrical and contorted root, 12 mm. in diameter, showing in section the peculiar wedge-shaped bundles of the wood. It has a somewhat bitter and pungent taste. The *Aristolochias* are stimulating tonics and are often given for snake bites. Locally the root is used for amenorrhea and as a pectoral and stomachic.

***Aristolochia rotunda* L. (Aristolochiaceae)**

نخود الوند

Nukhūd-i-alvand (Teh., Isf.); Nukhund-i-alavandi (Ar.); Zarahand-i-gird (Pers.); the roots.

W.H.M.M. 150761.

The roots are tuberous, brownish or gray, round in shape like a small cottage loaf, with a broad base, a top narrow and marked with pit-like scars and the remains of fallen stems. They are hard, horny, and starchy, and have an acrid odor and taste. The drug is given as a tonic, diuretic, emmenagogue, and vermifuge. In Iraq *A. Mauro-rum* L. is used by the tribes to provide an antiseptic for healing wounds, and also for curing scab in sheep (G.).

***Artemisia maritima* L. (Compositae)**

درمنه

Darmanah (Teh.); Afsant-el-bahara (Ar.); santonica, wormseed. Ph. Ind. 2: 288; Greenish and Maplethorpe, Y.B.Pharm. 1923, 646.

Field 179; K.B. 304.

The dried, unexpanded flower heads of various species of *Artemisia*—often mixed with *A. vulgaris* L. and water (H.F.)—are used as a vermifuge. The provinces of Turkestan and Kurdistan supply large quantities. Aitchison says that *A. maritima* L. and *A. campestris* are to be found everywhere in northeastern Iran. The rootstocks and dry stems are used for fuel, and the flower heads collected from the villages around Tehran are sold in the bazaars. Santonin, the active, anthelmintic principle of wormseed, is now manufactured near the town of Chimkent in Turkestan (Ph. Ind. 2: 288).

***Artemisia vulgaris* L. (Compositae)**

افستین

Afsantīn (Teh.); Afsantīn-i-hindi (Ar.); wormwood. Ph. Ind. 2: 284.

Field 180; W.H.M.M. 150753; K.B. 305.

The specimens of this drug are broken pieces of stalks, leaves, and flower heads, matted together with woolly hairs. They have a fragrant aroma and bitter taste. The origin of this ancient drug, described by Mohammedan physicians, is probably *A. absinthium* L., but other species are used. *A. ponticum*, a plant growing in Europe and in the Caucasus region, is quoted by Schlimmer as the source of the drug sold in his day in Tehran. Absinthium is a bitter, stomachic tonic; it increases the appetite and promotes digestion. The Persian name of these plants has been given to absinthe, a well-known liqueur used in Europe.

Asarum europaeum L. (Aristolochiaceae)

اسارون

Asārūn (Teh.); snake root.

W.H.M.M. 150765.

This drug consists of rhizomes, thicker than a pencil, knotted, with circular marks above and long, light brown rootlets below. The wood is yellowish, bitter, and rather fragrant. The drug is employed as an emetic, diaphoretic, diuretic, and purgative, and is prescribed for rheumatism and apoplexy.

Asparagus adscendens Roxb. (Liliaceae)

مازچوبه

Mārchūbah, Khushak (Ham.); Satavar, Satarmul, Shakakula micari (Hind.); Sufed musli, of commerce (Bom.); white musali.

Ait.; Schl.; Post; Boiss. 5: 339; Ph. Ind. 3: 482.

Field 416; K.B. 305.

The roots of several species of *Asparagus* are used in the East for medicine, including those of *A. officinalis* L., *A. sarmentosus* Willd., and *A. racemosus* Willd. The root from Hamadan is in long, thin pieces, 2 to 3 mm. in diameter, ivory-white, hard, horny, wrinkled longitudinally, and somewhat twisted. It swells in water and becomes mucilaginous. The root is considered to have stimulant and diaphoretic properties.—As a diaphoretic it is mixed with sheep's fat and rubbed on the chest (H.F.).

Asparagus officinalis L. (Liliaceae)

هليون

Haliyūn (Teh.); common asparagus berries.

W.H.M.M. 150767.

بیخ هلیمون

Bikh-i-halimun (Teh.); asparagus root.

Field 161; W.H.M.M. 150741.

The berries are scarlet, the size of a pea, holding two seeds in each cell. They contain grape sugar and sparganein, a coloring matter; the seeds contain a fixed oil and aromatic resin.

The roots are twisted, black on the outside, white and horny within, mucilaginous when soaked in water, with a mawkish and sweet taste. In Tehran the roots are burned and the smoke is inhaled to relieve toothache.

***Asperugo procumbens* L. (Boraginaceae)**

باد رنجه بویه

Bād-i-ranjah-būyah, Bār ranjūbah (Teh.); madwort, the herb. Schl.; Boiss. 4: 275; Post, 540; I.H.B.

Field 198; W.H.M.M. 150807; K.B. 306.

This is a prostrate herb in Arabia, Iran, Europe, and North Africa. It is common in cultivated fields and gardens. The fruiting calyx is reticulate-veined, with acute, ciliate lobes. The substitution of this plant for the well-known, fragrant drug, Badrandj-boia, a remedy for asthma, still persists in Iran. Schlimmer writing about *Asperugo* says, "This plant, dried, is sold by the druggists of Tehran under the false name of Badrendj-bou-yeh, which is the true name of *Melissa cedronella*. I have never been able to understand the reason of this sophistication, to which Dr. Haussknecht was the first to call attention, because the true *Melissa* is largely cultivated in the gardens about Tehran."

***Astragalus fasciculaefolius* Boiss. (Leguminosae)**

کنجد سرخ و سفید

Kunjidah-i-surkh u safid (Teh.); Kunjad, Gujar (Bom.); Kunjada, "resin for bleeding" (Ait.); Anzarut (Ar.); Sarcocolla, "flesh glue" (Gr.); Kohl Farsi (Persian collyrium), Kohl Kirmani (Kirmani collyrium); the gum.

Ait. 18; Ph. Ind. 1: 476; D. Hooper, Journ. As. Soc. Bengal, 9, No. 4, April, 1913, pp. 177-181; Achundow; Schl.; Boiss. 2: 396.

W.H.M.M. 150788; K.B. 306.

This is a sweet exudation secreted by the above plant obtained from Kurdistan and exported to India and elsewhere. It occurs in pale, yellowish brown fragments, brittle in consistency, soluble in

water and alcohol, odorless but with a sweetish taste. It contains a principle similar to glycyrrhizin. *Sarcocolla* forms a plaster long used by Parsi bone-setters, and is applied locally to the ears and face to allay neuralgic pains. Aitchison says the gum is used by ladies of the harem to improve their appearance and to give the skin a gloss (see "*Sarcocolla*" by D. Hooper; *Journ. As. Soc. Bengal*, Vol. 9, 1913, pp. 177-181).

***Astragalus gummifer* Labill. (Leguminosae)**

کتیرا

Kathirā (Teh.); Qatera, Katira gond (Hind.); gum Tragacanth. Field 128; W.H.M.M. 150861.

The small, branching, thorny shrubs of *Astragalus* are especially to be found in Asiatic Turkey and Iran, where they form one of the most characteristic features of the vegetation. The above and other species yield, when incised, flat, ribbon-shaped pieces, or, when punctured, vermiform tears. The tragacanth gum from Tehran is in clean white ribbons, typical of the best commercial quality, largely used in medicine and confectionery.

***Astragalus hamosus* L. (Leguminosae)**

اکلیل الملک

Iklil (Teh.); Iklil-ul-malik (Ar.); Adhafir-aj-jian, Adhafir-ash-shaitan (Iraq); Iklil-ul-mulk (Bom.); Aketi (Ham.); the curved pods. Field 145; W.H.M.M. 150889; K.B. 342.

The origin of this drug has been referred to various species of *Melilotus* and *Trigonella* which have curved pods. Those received from Tehran and Hamadan are horseshoe-shaped, 2.5 cm. in length, grayish brown, smooth, curved outward, grooved on both sides, and beaked; they are divided by a central partition and contain grayish yellow, rhomboidal seeds, notched at one end and with black spots. The pods are called in Iraq "Fairies' Nails" or "Devil's Claws," and are used for various disorders, but chiefly as a suppurative and astringent. Sometimes they are made into a plaster for reducing tumorous and painful swellings.—Mixed with *Viola* sp., they are taken before purgation (H.F.).

***Bambusa arundinacea* L. (Gramineae)**

تابا شیر قلمی

Tabāshir-i-qalamī (Teh.); Tabashira (Ar.); Bans lochan (Hind.); mineral concretion in stems of bamboo.

Field 244.

Tabashir is a siliceous concretion found in the hollow stems of bamboo plants, and is a valuable Hindu medicine. It occurs as hard, white, opaque, mineral-like fragments of various shapes. The sample from Tehran, bearing the above vernacular name, consisted of burnt bones, and was not true tabashir.—It could not, however, be considered a fraudulent substitute for the authentic drug, as it was labeled "Calcined bones for toothpowder" (H.F.).

Berberis vulgaris L. (Berberidaceae)

زرشک کلی

Zirishk-i-gulī (Ham., Teh.); Zarishk (Hind., Bom.); the fruits. Achundow; Ait.; Schl.; Boiss. 1: 103; Ph. Ind. 1: 65.

W.H.M.M. 150841; K.B. 306.

The Indian barberry is a common shrub growing in the hilly districts of India and Iran, and the berries are largely collected and appreciated as a condiment or made into jam. In the Punjab the fruits and preserve are called Zirishk-tursh (sour currants) to distinguish them in the trade from the small, black, dried grapes known in Europe as currants or corinths. The consumption of these acid fruits in medicine is said to relieve itch and other skin complaints.

—A specimen of dried *Berberis* fruits in the collections of the American School for Boys, Baghdad, bears the label Zirishk. Barberries are used as a decoction for general health and to sweeten the breath (H.F.).

Beta vulgaris L. (Chenopodiaceae)

تخم چقندر

Tukhm-i-chuqundur (Teh.); Chuk-andar (Hind.); common beet. Field 28 (Iraq); W.H.M.M. 150787.

These are small, cup-shaped fruits with light brown seeds, which taste saltish. In Iran they are cultivated largely as a vegetable. The seeds of the beet are sold in Indian bazaars for medicinal use under the name of Chukander (Ph. Ind. 3: 148).

There are several varieties grown in Iraq:

- (1) Beetroot. Chukundar (Turk.). The root is eaten.
- (2) Spinach beet. Siliq (Turk.); common. The leaves are cooked and eaten as a substitute for spinach.
- (3) Sugar beet. Shuwandar sukari. Climate of the Baghdad area is unsuitable for cultivation.

- (4) Mangel-wurzel should succeed in Kurdistan.
- (5) Wild beets, known as Silajiah or Silaigah.

Boswellia Carterii Bird. (Burseraceae)

کندر

Kundur (Teh.); Seta Kundura (Hind.); frankincense or olibanum.
Field 199.

There are several kinds of this fragrant oleo-gum-resin found in commerce. Kundura zakara, "male frankincense," is in reddish or deep yellow, circular tears; Kundura unsa, "female frankincense," is in yellowish white, translucent or pale tears; Kisher Kundur or Dhupa of the bazaars occurs in scaly pieces of the bark coated with the exudation.—Olibanum is used chiefly as incense; it is an ingredient in plasters; a dose of half a misqal (35 grains) is said to improve the memory (H.F.).

Brassica campestris L. var. **Napus** Bab. (Cruciferae)

تخم شلغم

Tukhm-i-shalgham (Teh.); Sarsun (Hind.); rape or colza seed.
Field 54 (Iraq); W.H.M.M. 150856.

This is an important crop in India and elsewhere, cultivated chiefly for its seed. Rape seeds are small, brownish or reddish brown, 2 mm. in diameter, smooth. They yield by expression a bland oil used as an emollient and in cooking and lighting.

Brassica (Sinapis) **nigra** (L.) Koch, and **B. alba** Rabenh. (Cruciferae)

خردل

Khardal.

Mustard, now a widespread weed, is of Eurasian origin. The powdered seeds are an important condiment, used in curries, and medicinally in the preparation of poultices and plasters. Mustard is taken internally as an emetic in cases of narcotic poisoning (G.).

Butea frondosa Roxb. (Leguminosae)

برک هند ایران

Barg-i-hind irān, Parakeh-i-hindī (Teh.); Palaspapado (Duk.); Palas Keby (Hind.); seeds of bastard teak or Bengal kino tree.
Field 181; W.H.M.M. 150818.

These seeds are flat, reddish brown, 5 by 3 cm., containing white cotyledons. The seeds are an Indian remedy for tapeworm. The powdered seeds are prescribed two days after a dose of wormseed.

Caesalpinia Bonducella Roxb. (Leguminosae)

تخم ابلیس

Tukhm-i-iblis (Teh.); Khaza-i-iblis, "Devil's testicles"; Bonduk-i-hindi (Ar.); Kat karanj (Hind.); bonduc nut, nicker tree.

W.H.M.M. 150709.

Bonduc seeds are globular, smooth, dull gray in color, and yield an oil by expression. They are worn as necklaces for charms, and the kernels are bitter, tonic, antiperiodic, and anthelmintic.

Calamintha graveolens Benth. (Labiatae)

ترنگمسک

Terengamisk(?) (Teh.); Faranj mishk or Biranj mishk; Palang mishk has been referred to *Ocimum sanctum* L., and Palenguemeeke by Schlimmer to *Dracocephalum Kotschyi* Boiss.

Boiss. 4: 583; Post 624.

Field 32; K.B. 306.

This species of calamint frequents the Mediterranean region, Syria, Asia Minor, Iraq, and Trans-Caucasia. The seeds are known in India, where supplies come from Iran. They are dark brown, oblong in shape, 2 by 1 mm., three-angled, tapering toward the umbilicus, where there is a white, V-shaped mark; they are feebly pungent and become coated with transparent mucilage when soaked in water. The seeds are stimulating and aphrodisiac.

Calendula officinalis L. (Compositae)

همیشه بهار

Hamīshah bahār (Teh., Iraq); Gole himmicheh behar (Schl.); Qarah Koz (Turk.); marigold flowers.

Field 123.

The pot marigold, a plant of the Mediterranean coast, is a weed of cultivation in northern India, and is much grown in gardens for its ornamental flowers. The yellow flower heads are bitter and have long been used among domestic remedies. "A tincture made from the dried florets was formerly used in medicine for application to wounds" (Guest).

Capparis spinosa L. (Capparidaceae)

ريشه كبار

Rishah-i-kabar (Teh.); Kabar (Pers., Iraq); the bark.

Ph. Ind. 1: 131; Boiss. 1: 420.

Field 200; W.H.M.M. 150803; K.B. 307.

The thorny caper is found in western Asia, Europe, North Africa, and Australia. It is a common shrub in the open country, forming great bushes fully 5 feet high.

Throughout Iran the flower buds are collected to be made into pickles. The light-colored root and the thick root bark are used in medicine, the bark being the *Capparis Cortex Radicis* of the old "Persian Pharmacopoeia." They are both pungent and bitter and are given for intermittent fever and rheumatism.

Capsicum frutescens L. (Solanaceae)

فلفل مويه

Filfil müyeh, Filfil-i-surkh (Teh.); Filfil ahmer (Ar.); Lal mirch (Hind.); red pepper, bird pepper, chilies.

Field 96A, 111A; W.H.M.M. 150914.

This species of peppers or chilies, *Capsicum* and *C. annuum*, are cultivated throughout India and Iran for their pungent fruits, and are used throughout the East for culinary purposes. Capsicums and their preparations act as a powerful local irritant. In medicinal doses chilies stimulate the alimentary canal, promoting the flow of gastric juice "to increase appetite and aid digestion."

Carthamus tinctorius L. (Compositae)

كافشه

Kāfshah, Tukhm-i-kāfshah (Teh., Ham.); the seed.

Gul-i-rang (Teh.); Gul-i-kajira, Qurtum (Ar.); Kusam (Hind.); *Atractus* (Gr.); safflower, the flowers.

Ait.; Post; Schl.; Laufer 324; Ph. Ind. 2: 308.

Field 33, 39A, 195; W.H.M.M. 150866; K.B. 307.

The safflower plant is cultivated in Syria, Iran, and Afghanistan as a field crop for its red florets, which are used as a dyestuff and cosmetic. The red flowers are often supplied as a cheap substitute for saffron, the stigmas of *Crocus sativus* L.

The fruits or achenes, called parrot seed, the size of barley grains, yield by expression an oil which is used as a salve for sprains and rheumatism.

Carum Bulbocastanum Koch (Umbelliferae)

زیره سیاه کرمانی

Tukhm zīreh (Teh.); Zireh-siyah, Kirmani (Isf.); Kala-zirah (Afg.); Jira-shak (N.E. Pers.); black caraway.

Field 35, 441; W.H.M.M. 150909.

These fruits constitute the spice called black caraway of Iran and northern India. Royle described the plant yielding these fruits as *Carum nigrum*, but Aitchison was the first to observe that they were collected from a plant with tuberous roots. They are a substitute for the ordinary caraway of Europe (*C. Carui* L.), and are used in medicine as a carminative.

Carum copticum Benth. & Hook. (*Sison Ammi* L.; *Trachyspermum Ammi* Sprague ex Turrill; *Ptychotis Ajowan* DC.; *Ammi copticum* L.) (Umbelliferae)

زنان

Ziniyān (Teh., Ham.); Ajowan, Ajwain (Hind.); Omum (Tam.); Ammeos (Ph. Pers.); Basilikon Kuminon (Gr.); bishop's weed, the fruits.

Boiss. 2: 898; Fl. Br. Ind. 2: 682; Ph. Ind. 2: 116.

Field 17; W.H.M.M. 150750; K.B. 308.

This is an African plant, cultivated in Europe, Iran, Afghanistan, and throughout India. The aromatic fruits were a well-known medicine among the ancient Greeks and Arabs. The Irani drug is produced largely in the province of Shiraz. The fruits are brownish gray, smaller and more curved than caraway seeds. The fragrance and active principle reside in an essential oil holding a stearoptene, called thymol, which crystallizes out at ordinary temperatures. Thymol is known in India as Ajwain-ka-phul or "Flowers of Ajwain." The distillate obtained from the fruits when boiled with water is called "Omum water," and is used as a carminative for children and as a cholera remedy.

Carum Petroselinum Benth. & Hook. (Umbelliferae)

تخم کلم

Tukhm-i-kalam (Teh.); Maghdunes (Iraq); Pitar saleri (Hind.); parsley seed.

W.H.M.M. 150829.

Parsley is a plant of southern Europe, cultivated in kitchen gardens for its leaves, which are used as a condiment. The fruits

are a grayish green or greenish brown, 2 mm. long and 1 to 2 mm. thick, laterally compressed; the odor and taste are aromatic. The chief constituent is a volatile oil containing apiol which, on standing, separates in crystals (parsley camphor). Commercial apiol is a viscous, oily liquid prepared by extracting the seeds with ether. The fruits are aperient and febrifuge, and apiol is given for dysmenorrhea and amenorrhea.

Cassia Absus L. (Leguminosae)

چشم

Chasm (Ham., Teh.); Hab-us-sudan (Ar.); Chaksu seed of India; Egyptian cassia seed.

Ph. Ind. 1: 524; Fl. Br. Ind. 2: 265.

Field 155; W.H.M.M. 150817; K.B. 308.

This plant is widely distributed in the tropics of the Old World. The small, black, lens-shaped seeds have long been known in the East in the treatment of eye diseases; Chaksu in Sanskrit means "an eye." In some districts a plaster made from the seeds is recommended as an application for wounds and sores. In Hamadan the seeds are classed among the poisons.

Cassia acutifolia Delile (Leguminosae)

سنا

Sanā' (Teh.); Sana mukhi (Iraq); Sana-hindi (Ar.); senna.

Field 143, 44A; W.H.M.M. 150844.

Senna leaves are imported into Iran from India. In Tehran they are used as a purgative, mixed with a confection of rose leaves and tamarind.

Cassia Fistula L. (Leguminosae)

فلوس

Fulūs (Isf.); pods.

Field 15 (Isf.), 415.

The purging cassia is a tree indigenous to India, where the long, cylindrical pods are collected and the sweet pulp is used largely in medicine and exported. According to Aitchison, Folusi is the Turki name for the tree in Yarkand, western Sinkiang, China.

—As a remedy for pyrosis, the central portion of the stem is boiled, the liquid filtered and sugar and almond oil added. Directions are given to drink it early in the morning on an empty stomach and at

intervals during the day. Bread must be omitted from the diet during the time of medication (H.F.).

Celosia argentea L. (Amarantaceae)

کل حلوا

Gul-i-halvā (Isf.); Sarwali (Hind.); cockscomb seeds.

Field 408.

The plant grows throughout India and tropical Asia. The pinkish and yellow flower heads, seeds, and roots are used in medicine. The seeds are lenticular, brown or black, smooth, shining, convex on both surfaces. The leaves are used for poultices; the flowering tops with seeds are given as a nervine tonic and in diarrhea. The author of the "Muffaridat-i-Nasiri" states that 180 grains of the seeds, with an equal quantity of sugar candy, taken daily in a cup of milk, is a powerful aphrodisiac.

—Mixed with *Chrozophora verbascifolia* Juss., the seeds are given as an infusion for chest pains, especially during whooping cough (H.F.).

Celtis australis L. (Ulmaceae)

دغ دغان

Digh-dighane (Isf.); nettle tree.

Field 70.

This ornamental tree is cultivated in Khorasan and near Baghdad, frequently near shrines and holy places. The small, green, wrinkled fruits of *C. caucasica* Willd. are mixed with ordinary flour to be made into bread.

C. Tournefortii Lam., Tawak in Kurdistan, bears small edible fruits like cherries.

Chaerophyllum sp. (Umbelliferae)

قردمانا

Qurdumānā (Teh.); Keruwiah (Isf.); the fruits.

W.H.M.M. 150836.

These fruits are gray-green, elongated, 10 by 1 mm., with a faint caraway odor. Honigberger refers the Arabic Kurdamana to *Lagaecia cuminoides* having similar properties. Stapf informs us that Keruwiah brought from Chahār Mahal and sold for medicine in Isfahan is an allied umbelliferous plant, *Grammosciadium macrodon* Boiss. They are both carminative medicines.

Chahār-tukhmah. The four seeds.

چهار تخمه

In the Field collection there are two samples (183 Tehran and 16 Iraq) labeled "Chahār-tukhmah" and "Mixed seeds." They are sold as a tonic medicine and remedy for diarrhea. The four seeds are Barhang (*Plantago major* L.), Gudamah (*Alyssum campestre* L.), Sepistan (*Cordia Myxa* L.), and Bihidana (*Pyrus Cydonia* L.). It will be noticed that all these seeds are very mucilaginous. Aitchison also refers to a mixture of four seeds sold in the Punjab and Yarkand called "Kam-parah." Kam means "little or deficient," and parah "a portion or piece," suggesting that the four seeds combined make up the whole or perfect remedy. This theory resembles the blending of the five cucurbitaceous seeds in India (see *Cucumis*), where the mixture represents the quintessence of a tonic prescription. The four seeds in the Yarkand collection are Barhang (*Plantago major* L.), Isparza (*P. ovata* Forsk.), Raihan (*Ocimum Basilicum* L.), and Marva (*Salvia* sp.).

Chrozophora verbascifolia Juss. (Euphorbiaceae)

برک قیطان

Barg-i-quitarān (Teh.); Zurrāij (Iraq); Nil-kanthe (Punj.); Shahdeve (Hind.); the herb.

Field 404, 405; W.H.M.M. 150719.

This is a common weed in cultivated ground, found in tropical India in the dry season. The drug consists of the leaves, stalks, and fruits of the herb, which are used locally for whooping cough. The plant is known for its alterative properties, and at one time was recommended for leprosy. The seeds, called "Tannum" in Kuwait, contain 35 per cent of a fatty oil, which is used by the Beduins of Arabia as a substitute for clarified butter. The plant is related to the turnsole (*C. tinctoria* Juss.) which, in addition to its yielding a purplish blue dye, has emetic and poisonous properties.

Cicer arietinum L. (Leguminosae)

نخود

Nakhūd (Teh., also Punj. and Turk. names); Chana (Hind.); Nok (Kurd.); Bengal gram, chick pea.

Field 66A, 68A.

The chick pea is a small, annual plant with pinnate leaves. The stems are covered with glandular hairs containing oxalic acid, which,

under the influence of dew, exudes and hangs in drops. This acid liquor is called Chana-no-kheto, and is valued medicinally. The seeds or pulse are gibbous, mucronate, and greenish gray in color. Chana is the favorite pulse of the natives of India, and is taken raw or parched or soaked in syrup as a confection. The seed is named "Nakhud," the name for an Irani weight equal to 1/144 ounce avoirdupois. The seeds weigh, on an average, 5 grains each.

Cichorium Intybus L. (Compositae)

تخم کاسنی

Tukhm-i-kāsni (Ham., Teh.); Kashi (Hind., Bom., Beng.); Intubus (Lat.); Sem. Cichorii (Ph. Pers.); the achenes (seeds) of chicory.

Kīshah-i-kasni (Ham., Teh.); chicory root.

Ph. Ind. 2: 311; Boiss. 2: 716; I.H.B.

Field 28, 254; W.H.M.M. 150812; K.B. 309.

The chicory plant is indigenous to Iran and is cultivated in India and Europe. It goes under the same name as endive, and the natives of eastern Iran do not distinguish between them (Aitchison).

The root is fleshy and tapering, wrinkled longitudinally, and brown on the outside. The dried and torrefied root is known as an ingredient often mixed with commercial brands of coffee. In Iran, Baluchistan, and India it is a resolvent and cooling medicine for bilious attacks. —For this purpose it is sometimes mixed with *Viola* sp., *Nymphaea alba* L., and *Cordia Myxa* L. (H.F.). The achenes are angled, of pale, mottled gray and have a bitter, mucilaginous taste.

Cinchona Calisaya Wedd. (Rubiaceae)

پوست کینه

Pūst-i-kinah-kinah (Teh.); Qanaqinah (Iraq); cinchona or quinine bark.

Field 125A; W.H.M.M. 150905.

Cinchona bark is sold in small quantities in the Eastern bazaars from Iran to China. It was introduced into Europe in the 17th century when brought over as Kina Kina, or Peruvian bark, by the Jesuit missionaries from South America. After its admission in 1677 to the "London Pharmacopoeia" it was sent out to the physicians of the East India Company. In 1760 the bark powder was being sold in the apothecary shops in Calcutta at Rs.3 per ounce. In 1860 the cultivation of the cinchona tree was established in India, and quinine is now being manufactured in that country in addition to the supplies coming from Java.

Cinnamomum Cassia Blume (Lauraceae)

دارچینی

Dār-chīnī (Isf., the Hindi name); Darasini (Ar.); Chinese cinnamon bark.

Field 14 (Isf.), 108.

The cinnamon bark from China is kept by druggists, and is a favorite spice. It is used in curry and as an ingredient in medicines. The bark is prepared as a tea for excessive salivation, frequent in Iran.

قرقه

Gurfah (Teh.); Kalphah (Bom.); the fruits.

W.H.M.M. 150867.

The small, black fruits of the cinnamon tree from China are sold in the bazaars. In South India the fruits of *C. iners* Reinw. are used in medicine, but are inferior to the above.

برگ ساذج

Barg-i-sādhaj (Teh.); Sādhaj-i-hindī (Isf.); the leaves.

Field 17 (Isf.); W.H.M.M. 150884.

The leaves of the cinnamon are taken internally for rheumatism. The vernacular name is applied by the Indian Mohammedans to the leaves of a wild cinnamon tree in Sylhet used as a carminative and stimulant (Ph. Ind. 3: 209). The leaves constitute the ancient Hindu drug known as Malabathrum, Talispatra, and Folia indica.

Cirsium lanceolatum L. (Compositae)

Foveh (?) (Ham.); thistledown.

Achundow; Boiss. 2: 538; Post.

K.B. 309.

Under this name the white, feathery pappus or thistledown from the above plant is sold in the bazaars. A medicine called "Badawerde" (carried by the wind) consists of the pappus of the holy thistle (*Cnicus benedictus* L.). The downy heads of species of *Voluntarella* and *Echinops* are also used as a drug, probably as an absorbent material for external application.

Citrullus Colocynthis Schrad. (Cucurbitaceae)

خر بوزه روباه

Kharbūzah-rūbāh, Kabiste talkh (Pers.); Hanzal (Ar.); Handhal, Gozharik (Kurd.); Indrazana (Hind.); colocynth, bitter apple, Indian gourd.

Field 106 (Iraq); 77A (Iran and Iraq).

The colocynth is a trailing, perennial herb with mottled, green or yellow fruit about the size of a large orange, and is common in sandy desert regions in northern India, Iran, and Syria. The rind is brittle and the inner surface is covered with a soft, spongy, white substance with an intensely bitter taste. This pulp, made into an extract, is official in all the pharmacopoeias.

This is a drastic hydragogue cathartic, due to the presence of colocynthin, a crystallizable glucoside. The small, oval, brown seeds contain about 17 per cent of a fixed oil, and, with albuminous matter and salts, are edible and nutritious.

Citrullus vulgaris Schrad. (Cucurbitaceae)

تخم کرمک

Tukhm-i-garmak, Tarbuz (Teh.); Qarpuz (Turk.); Shami (Iraq); watermelon.

Field 73A, 94A; W.H.M.M. 150728.

This melon is cultivated throughout the country in the summer. The fruit is well known for its refreshing pulp, and is sometimes used as a source of water. For two months in the year the watermelon, with a little bread, may be looked upon as the food and drink of the people (Aitchison). The seeds are collected, sold, and eaten, with or without salt; they are chewed as a pastime and considered to have medicinal properties. The seeds also comprise one of the five cucurbitaceous seeds of Hindu medicine, the other four being: *Cucumis sativus* L. (cucumber); *C. Melo* L. (muskmelon, Kharbuz); *Lagenaria vulgaris* Ser. (bottle gourd or Dudhi); and *Benincasa cerifera* Savi (white tallow gourd, Kodu). They are cooling, diuretic, and nutritive.

Citrus aurantifolia (Christm.) Swingle (Rutaceae)

ليمون

Limon, Limon-amman or Limmon Basra (Iraq); Post-i-limon (Afg.); Basra lime.

Field 43A.

Hard, dry lemons or limes the size of a nutmeg, these fruits (Numi Basra) are imported into Iraq from India, and used with sugar for making a beverage called Shai Hamidh (G.).

Citrus sinensis (L.) Osbeck (Rutaceae)

Four products of the orange tree are used in medicine in Iran:

بهار نارنج

Flowers: Bahār-i-nāranj, "spice of orange" (Teh.); *Naphae flores* (Schl.); neroli.

Ph. Ind. 1: 270.

Field 219; W.H.M.M. 150778; K.B. 309.

The dried flowers of the cultivated orange are sold in bazaars and recommended as a stimulant and to prevent dysentery. Schlimmer refers to *Aqua florum aurantii* or *Aqua naphae* as a favorite flavoring agent. The oil contains a nitrogenous substance of exceeding fragrance, anthanilic acid methyl-ester.

برک نارنج

Leaves: Barg-i-nāranj (Isf.).

Field 429.

Among other uses, the leaves of the orange tree are applied to reduce swollen legs.—For this purpose they are sometimes mixed with *Taxus baccata* L., orange seeds, bitter cane, and hemlock fruits (H.F.).

خلال نارنج

Orange peel: Khalal-i-nāranj, Pust-i-utruj (Teh.); the peel or pericarp in thin shreds.

Field 153; W.H.M.M. 150804, 150896.

Orange peel is an ingredient in the preparation of tincture of cinchona and tincture of gentian. In domestic cookery in Iran it gives a flavor to boiled rice and other vegetables.

Post-i-nāranj is the fruit which, cut in two and dried in the sun, is sold in the bazaars.

هسته نارنج

Seeds: Hastah-i-nāranj (Teh.).

Field 431.

Orange seeds or pips are bitter. They are first torrefied to remove the husks, and are taken as a stimulating remedy.

***Colchicum luteum* Baker and *C. speciosum* Stev. (Liliaceae)**

سورنجان کرمانی

Surinjān-i-kirmānī (Teh.); Surinjān-i-talkh (Pers.); *Hermodactyl*, "the finger of Hermes" (Gr.); the corms.

Achundow; Ph. Pers.; Boiss. 5: 155; Schl.; Ait.; Ph. Ind. 3: 496.

Field 14; W.H.M.M. 150857; K.B. 310.

The yellow-flowered *Colchicum* is found on grassy slopes in the temperate Himalayas, and in Afghanistan and Turkestan. *C. speciosum* Stev. is met with throughout the Badghis, Harirud, and Khorasan. The corms or bulbous roots are mixed with those of *Merendera persica* Boiss., which constitute the Hermodactyls of the later Greeks (Aitchison). The corms are ovate, 3.5 to 5 cm. long, white, hard, and horny. The starch is muller-shaped with a hilum. Both species afford the alkaloid, colchicine, and are used, as is *C. autumnale* in Europe, for rheumatism.—Powdered, they are given as an infusion for phthisis (H.F.).

Commiphora Molmol Engl. (Burseraceae)

خاک مقل

Khāk-i-mugl, Mun-e-makki (Teh.); Mur, Bol (Hind., Bom.); Myrrha mechensis (Ph. Pers.); oleo-gum-resin.

Abu Mansur; Schl.; Pharmacog. 125; Ait.; Ph. Ind. 1: 304.

Field 204; K.B. 310.

The fragrant oleo-gum-resin known as myrrh is one of the most ancient drugs in the Orient. It is obtained from plants growing in northeast Africa and South Arabia, and is brought to India, where Bombay is the center of the trade. Aitchison says it is imported into Meshed through Iran for further transport to Afghanistan and Turkestan. Myrrh is an important drug among Mohammedans, who suppose that it originally came from Mecca.—The sample from Tehran is in the form of grains; made into pills it is used as a stomachic and for lumbago. The dose is five pills (H.F.).

Commiphora Mukul Engl. (Burseraceae)

مقل ازراق

Muql-i-azrāq (Teh.); Moghl-ezregħ (Schl.); Gugal, Bdeillum (Hind.); Indian bdellium.

Ph. Pers.; Tschirch; Pharmacog.; Ph. Ind. 1: 311.

Field 245; W.H.M.M. 150703; K.B. 310.

The Mohammedans describe the different kinds of bdellium under the name of Muql (Mukul), and say that it is the product of a tree common in Arabia and India. Several kinds are distinguished, all of them bitter gum-resins. That with a bluish tinge is termed Muql-i-azrāq; with a yellowish tinge, Muql-i-yahud; brown, Sakulali;

and with a rich, red-brown color, Muql-i-abair. Sticky and bitter, the Irani samples form milky emulsions with water. The drug is given in muscular rheumatism and is applied to painful parts in the form of a "lep" or native plaster.—One misqal of the drug is given for insomnia (H.F.).

Commiphora opobalsamum Kunth (Burseraceae)

حب بلسان

Habb-i-balsān (Isf.); Hab-el-balasana, Akulla, Balasan (Ar.); balm of Gilead, balm of Mecca.

Field 445.

The fruits of this tree of Arabia are oval, pointed, wrinkled, reddish brown; the taste is balsamic, with an odor resembling that of turpentine. The fruits are carminative, stomachic, expectorant, and stimulant; in Isfahan, for shivering and colds, a few of the fruits are swallowed whole.

عود بلسان

'Ud-i-balsān (Isf.); wood.

Field 444.

The wood of the balsam tree, *Xylobalsamum* of Dioscorides, is pinkish and heavy in texture. It is found in pieces covered with layers of papery bark. The wood has properties similar to those of the fruit.

Conium maculatum L. (Umbelliferae)

بسخ شونکران

Bikh-i-shankarān (Isf.); Karedemonah (Ham.); Kurdumana (Hind.); Karvaya-i-dashti (Pers.); Khorasain-ajwan (Ind. bazaars); conium or hemlock fruits.

Boiss. 2: 922; Ph. Ind. 2: 110.

Field 433; K.B. 311.

The hemlock is a poisonous plant distributed through Europe and northern Asia. Aitchison found the plant, fully 7 feet in height, in Karabakh. Arabian and Persian physicians repeat in their writings the opinion of the Greeks in regard to hemlock. The fruits and leaves contain a poisonous alkaloid, conine, which paralyzes the motor nerves. The fruits are used locally, in the form of a lotion, to allay pain.

Coptis Teeta Wall. (Ranunculaceae)

مامیران

Māmīrān (Teh.); the rhizome.

Field 156.

Mamiran is a drug known to the early Indian traders. Bernier, who visited Kashmir in the train of the Emperor Aurangzebe, mentions it as a medicine good for the eyes, which was brought into that country from Tibet. The plant is cultivated on the outskirts of virgin forests in the mountains of western China, and is sent to India by way of Singapore. The roots are thin, knotted rhizomes with a yellow interior. They contain the alkaloid, berberine, and are used as a collyrium, and as a general tonic.

Corchorus olitorius L. (Tiliaceae)

ملوغيه

Mulukhiyah (Iraq); Baphalli (Hind.); Rajajira, Isband (Bom.); Jew's mallow, jute, the seeds.

Field 55, 69, 71 (Iraq).

This species of jute was introduced from Egypt and is cultivated as a vegetable. The fiber, not being suitable for cordage, is extensively used in surgery as a cheap drainage material (Post). The seeds of the bitter *Corchorus* (*C. trilocularis*) were known to the Greeks. The seeds are dark bluish green, angular, 2 mm. long, and very bitter. An infusion is given in fevers and in cases of congested liver.

Cordia Myxa L. (Boraginaceae)

Sepistān (Teh.); Sebestan or Sapistan, from Sagpistan, "dog's dugs" (Pers.); sebestan plums.

Achundow; Ph. Pers.; Schl.; Post 532; Boiss. 4: 124; Ait.; I.H.B.; Ph. Ind. 2: 518; *Cordia Myxa* and Allied Species, J. Hutchinson, Kew Bull., 1918, 217.

Field 11; W.H.M.M. 150724; K.B. 311.

Cordia Myxa L., the *Arbor glutinosa* of Rumphius, is a common shrub or small tree frequently cultivated and found in regions extending from Egypt to Indo-China and tropical Africa. Sebestan is a well-known drug in the Orient, introduced by the Arabs. It is a drupe the size of a cherry with mucilaginous properties. Aitchison says the fruits are imported chiefly from southern Iran to be employed

in medicine, and are forwarded in great quantities to Turkestan.—On account of their demulcent properties, they are useful for coughs and chest complaints; the dose in Tehran is said to be ten fruits (H.F.).

Coriandrum sativum L. (Umbelliferae)

تخم کشنیز

Tukhm-i-gishniz (Teh.); Kuzbara (Ar., Iraq); Gashnish (Turk.); Dhanya (Hind.); Koriyan (Gr.); coriander fruits.

Achundow; Schl.; Laufer; Fl. Br. Ind. 2: 177; Ph. Ind. 2: 129.

Field 30, 33A; W.H.M.M. 150918; K.B. 311.

The coriander plant is cultivated in gardens throughout Iran, Afghanistan, and India. The globular fruits are a well-known spice and flavoring agent. The plant is used in salads and curries, and an infusion of the leaves is said to relieve headache.—The fruits are smoked to relieve toothache (H.F.).

Corylus Colurna L. (Cupuliferae)

فندق

Funduk (Teh.); Findaq, Bundaq (Iraq); Findak (Hind.); Indian or Constantinople hazel.

Field 66 (Iraq), 48A.

A tree of the northwestern Himalayas, Kashmir, and Afghanistan, this is a relative of the European hazel (*C. Avellana*). Its nuts are generally plentiful in the larger markets of Iran and are said to come from the north. Filberts or cobnuts contain a large quantity of sweet oil and are eaten either raw or roasted.

Cotoneaster nummularia Fisch. & Mey. (Rosaceae)

شیر خشت

Shīr Khisht, Khushk=dried (Teh.); Shir-milk, (Pers.); a saccharine exudation.

Field 126.

This is a common shrub on the Sia-Koh and Safed-Koh ranges, at an elevation of 3,000 feet and upward. It yields in certain seasons, from its smaller branches, white, sugary lumps of manna which are considered aperient and stomachic.—Mixed with water, it is considered a remedy for typhoid (H.F.). This is one of the four varieties of manna met with in Iran; the others are Tar-anjabin (*Alhagi camelorum* Fisch.), Gaz-anjabin (*Tamarix gallica* L.), and Shahr-ul-

ashar or Shakar tiqāl, the product of a beetle on *Echinops persicus* Stev.

Shīr Khisht is eaten as it comes from the shrub, with food, or converted into a sweetmeat; sometimes it is exported to India.

Crataegus orientalis Bieb. (Rosaceae)

کیک‌واش

Kaik-vāsh, Kawich (Isf.); Ghich (Ham.); Gaiwuzh (Turk.); Alafkhareg (Afg.); the fruits.

Schl.; Boiss. 2: 660; Post; Ait.; I.H.B.

K.B. 312.

The Oriental hawthorn is a shrub or small tree of Asia Minor or the Caucasus. The fruits of most species are used in medicine, and those grown in the gardens at Ba'quba, Iraq, fetch a good price in the local market. The berries from Hamadan are pome-like, rounded, 12 mm. across, with a reddish brown, wrinkled pericarp, surmounted by an umbilicate disk of the minute lobes of the calyx; within are three oval, light brown, hard pyrenes. The fruits contain sugar, and are supposed to act as an opiate, while the seeds are used as a medicine for spermatorrhea.

Crocus sativus L. (Iridaceae)

زعفران

Za'farān (Teh.); Zafran (Ar.); Karkum, Abir (Pers.); Kesar (Kash.); Kesara (Hind.); saffron, hay saffron.

Field 2; W.H.M.M. 150720.

The saffron plant is cultivated in the neighborhood of Pampur in Kashmir and was formerly cultivated in Isfahan. It was grown in the 10th century in Spain, where the bulk of the European saffron is now produced. The dried, red stigmas of the crocus are a favorite coloring matter in medicine and food. The drug has a stimulant and antispasmodic action.

Croton Tiglium L. (Euphorbiaceae)

حب السلاطين

Habb-el-salatin, "Sultan's seeds" (Ham.); Habb-el-khatai, "Cathay (China) seeds"; Bidend jireh khatai, "castor oil seeds from China"; Habb-dilmaluk (Ait.); Jamalgota (Punj.); croton seeds.

Ait.; Schl.; Ph. Ind. 3: 281.

K.B. 312.

This small tree, indigenous to China and northeastern India, is now under cultivation throughout the greater part of India and the East. Croton seeds were known to the Persians at an early date, and were doubtless introduced from China by the caravan route through Central Asia. Described by Acosta in 1578, they were called Piñones de Malaca. The seeds contain a violently purgative oil, and are classified by the Iranis among the poisons.

Cucumis sativus L. (Cucurbitaceae)

تخم خیار

Tukhm-i-khiyār (Teh.); Khira (Punj.); Lār (Kash.); Kira (Hind.); cucumber seeds.

Field 34; W.H.M.M. 150754.

Cucumber seeds are ovate, pointed at both ends, 12 by 5 mm., notched at the apex; the cotyledons are oily and sweet.

The seeds are a favorite nutritive and demulcent, resembling in action and uses the five cucurbitaceous seeds (see *Citrullus vulgaris* Schrad.). The therapeutic action of cucumber seeds, from a local point of view, must be considered as somewhat negative, since they may be "mixed with any medicine the doctor prescribes."—They are given as an infusion for typhoid (H.F.).

Cucurbita Pepo DC. (Cucurbitaceae)

کل کدو

Gul-i-kadū (Teh., Ham.); Shijar (Iraq); Kadu (Hind.); flowers of the pumpkin.

Ait.; Schl.; Fl. Br. Ind. 2: 622.

Field 214, 92A; W.H.M.M. 150891; K.B. 312.

The pumpkin is largely cultivated as a vegetable in Iran and Afghanistan. The flowers, chiefly yellow or orange corollas, are sold in the bazaars. Made into a decoction, they may be applied to the face "to improve the complexion"; they are also administered internally for chest complaints.

تخم کدو

Tukhm-i-kadū (Teh.); the seeds of the pumpkin.

Field 65; W.H.M.M. 150766.

The seeds are light colored, oval, 2 by 1 cm., smooth, with a marginal rim. Like the seeds of other members of the gourd family, they form a nutritive and palatable addition to ordinary diet.

Cuminum Cyminum L. (Umbelliferae)

زیره سبز

Zirah-i-sabz (Isf., Iraq); Zira (Hind.); Jira (Beng., Bom.); Goi-zira, "green weed" (Turk. in Tabriz); Cummun (Syr.); the fruits.

Post 373; Gilliat-Smith & Turrill, Kew Bull. 1930, 390; Ph. Ind. 2: 113.

Field 438, 34A; W.H.M.M. 150792; K.B. 313.

The fruits of cumin are called green or white caraway to distinguish them from darker or black caraway (*Carum Bulbocastanum* Koch). The cumin plant is grown in gardens as a potherb, and the seeds, or properly fruits, are sold in the bazaars as a condiment and carminative medicine.—They are also prescribed to relieve pains after childbirth (H.F.). From the dawn of civilization in Egypt, its use spread into Arabia, Iran, India, and China.

Cupressus sempervirens L. (Coniferae)

کل سرو

Gul-i-sarv (Teh.); cypress fruits.

W.H.M.M. 150903.

The fruits of the cypress tree are reddish brown, opening by a five-parted covering, fragrant, and bitter. They contain an essential oil which has been recommended for whooping cough and as an anthelmintic.

Curcuma aromatica Salisb. (Zingiberaceae)

قرنباد

Qurunbād—this name is a corruption of Zurunbād (*Curcuma Zedoaria* Roxb.—(Teh.); Jangali-haladi (Hind.); wild turmeric, round or yellow zedoary tubers.

Field 146.

This is a contorted, yellow root, dressed with yellow powder, hard and orange brown within, having a delicate camphoraceous odor.—The powdered root is used for flatulence (H.F.).

Curcuma domestica Val. and C. longa Trim. (Zingiberaceae)

کرکم

Karkum, the Persian name for saffron (Teh.); Haldi (Hind.); Zard chobah, yellow root (Pers.); turmeric.

Field 73, 94; 73A, 74A.

These samples represent the rhizome and powdered root of turmeric. The root, called Indian saffron, is imported from India as a dye stuff, but is sometimes employed in Iran as a condiment. In medicine turmeric is a stimulant, tonic, and aromatic. Like other yellow roots, it is used in a decoction as a cooling lotion for conjunctivitis. Turmeric contains a yellow coloring matter, curcumin, and a thick, viscid oil.

Curcuma Zedoaria Roxb. and **C. Zerumbet** Roxb. (Zingiberaceae)

زرمباد

Zurunbād (Teh.); Kachura (Hind.); Uruk-el-kafur (Ar.); zedoary, long zedoary.

Field 148; W.H.M.M. 150910.

Zedoary is imported in quantity from India, most of it to be passed on to Turkestan. The root occurs in thin, transverse slices, 2 to 5 cm. in diameter, pale brown and wrinkled without, smooth and mealy within, odor camphoraceous, taste pungent and bitter. The drug, which is also employed as a condiment, is carminative and stimulant, and an ingredient in various alterative medicines.—It is recommended for relief of flatulence (H.F.).

Cuscuta planifolia Ten. and **C. hyalina** Roth (Convolvulaceae)

تخم کتوت

Tukhm-i-kushūth, Tukhm-i-kishvar, Resha-i-kishvar (Ham., Isf., Teh.); Gul-i-geshuz (Ham.); Kukil-i-pol, "moist silk" (Kash.); Aftīmūn, the herb; Kashūth is the Arabic name for dodder; Kassutha (Gr.); Cuscuta (Lat.), hence Keshus (Pers.); kill weed; seeds and flowers.

Boiss. 4: 117; Ph. Ind. 1: 548; Sci. Pa. 240.

Field 187, 226, 436, 437; W.H.M.M. 150734, 150782; K.B. 313.

Gul-i-keshus (the flowers) and Tukhm-i-keshus (the seeds) are exported from Iran to India mixed with the leaves and spines of the plants on which they grow. The seeds are light brown and have a bitter taste. The flowers are given for asthma—as an infusion, one cup, for catarrh (H.F.)—and for obesity the (thin, filamentous stems). The drug Aftīmūn, Epitymon (Gr.), is probably derived from *C. europaea*, a native of Europe and western Asia. It is given as a digestive and purifier of the blood, just as in Europe dodder is an ancient remedy for intestinal disorders such as constipation and flatulence.

—Dodder herb is given for rheumatism. Mixed with *Heracleum persicum* Desf. and gentian root, it is taken to stop excessive salivation (H.F.).

Cymbopogon Schoenanthus Spreng. (Gramineae)

اصفر مکی

Asfar-i-makki, Azkar (Teh.); Iskhir (Ar.); Khavi (Hind.); *Juncus odoratus*; *Herba Schoenanthi*; camel grass.

Ph. Pers.; Schl.; Ph. Ind. 3: 557; Oil-grasses of India and Ceylon, by O. Stapf, Kew Bull., 1906, 297.

W.H.M.M. 150785; K.B. 313.

The drug sent under these names is intended to represent the Irani and Indian drug Ishkar or Izkhir-i-jami, the stem and root of fragrant grass introduced originally from Arabia. The drug consists of the lower parts of the leafy stem with a few wiry roots and has a lemon-like odor. Kämpfer in his travels in Persia in 1683–1688 speaks of the distillation of the oil from the grass Izkhir (“Amoen. Exot.” 1712). Preparations of the grass are used locally for debility.

Cynara Scolymus L. (Compositae)

کنکر دهری

Kangar, Kangar-i-dahri (Isf., Teh.); Kinguere (Schl.); Ardi-shauki (Ar.); Anghinar (Turk.); artichoke seeds.

Achundow; Boiss. 3: 557.

Field 446; K.B. 314.

The artichoke is a cultivated plant in Iran. Its hard, white, polished fruits are used in medicine, and are said to be an antidote for opium poisoning. Kangar is a name applied in Iran to almost any thistle. Aitchison believes that it originated from the Persian name of an allied plant, prickly artichoke (*Gundulea Tournefortii* L.); this plant exudes an emetic resin (Kangar-zad) which is used medicinally.

Cyperus rotundus L. (Cyperaceae)

تا پالق

Tāpālaq (Teh.); So-ad (Ham.); Sa'ad (Iraq); Seid (Sud.); Motha (Hind.); Muschk-i-zemin, “earth musk”; Rad. Junci odorati (Ph. Pers.); Hsiang fu (Chin.); scented rush.

Achundow; Ph. Pers.; Ph. Ind. 3: 552.

Field 89A; W.H.M.M. 150755; K.B. 314.

The sedge grows plentifully in moist or boggy ground. The small, dark, hairy tubers are ovate-oblong, pointed at both ends, about 2.5 cm. or less in length, brown, hard, and horny. They have a fragrance resembling lemon and cardamom. These tubers are known in Asia for their perfume and medicinal properties; they are used for cleaning the teeth and are placed among clothes to keep away insects.

Datura Stramonium L. (Solanaceae)

تخم تاتورا

Tukhm-tātūrā (Pers.); Datura (Hind.); Jouj macel (Ar.); Shinah Azqhi (Bal.); stramonium thorn apple.

Ait.; Ph. Ind. 2: 586; Y.B. Pharm. 1927, 49; Synopsis of Genus Datura, W. E. Safford, Journ. Wash. Acad. Sci., 19 Apr. 1921.

K.B. 314.

The thorn apple grows in North, Central, and South America, and was introduced at a very early date into the warm regions of Europe, Asia, and Africa. This species is a weed in Iran, and the name has been borrowed from other countries. Specimens of the seeds came from Tehran and Hamadan and the leaves from Hamadan. Both seeds and leaves are used as poultices to allay pain. The natives recognize the poisonous properties of the seeds and sometimes call them Kachola, the name for the seeds of *nux vomica*, as both are used for killing dogs.

Daucus Carota L. (Umbelliferae)

تخم هویج

Tukhm-i-havīj, Tukhm zardak (Teh.); Jazr-ul-bostani (Ar.); Jazar, Gaizar (Iraq); Gajur (Hind.); Hawuch (Turk.); carrot fruits.

Field 120A, 203; W.H.M.M. 150887.

The carrot is greatly valued as a vegetable and much cultivated. The fruits are dull brown, oval, and compressed, the surface is rugose, marked with ridges which are distinctly winged, and the wings fringed with white teeth or bristles. The taste is balsamic, bitter, and oily. The fruit is stimulant, laxative, emollient, diuretic, and emmenagogue.

Delphinium Zalil Ait. & Hemsl. (Ranunculaceae)

اسپرگ

Isparak (Teh.); Asbarg, Aswarg, Zalil (other parts of Iran); Hishwarg (Bal.); flowers of yellow larkspur.

Field 36.

The yellow larkspur is a perennial herb in desert regions of Iran and Iraq, with shoots 2 feet high, each bearing a terminal spike of yellow flowers. The dried petals are of commercial importance, yielding a valuable yellow dye for silk, and are exported for this purpose in large quantities to Turkestan, Afghanistan, and even to India, where the flowers, to a small extent, are employed in medicine.

Dolichos Lablab L. (Leguminosae)

لوبياكل

Lūbiyā-gul (Teh.); Sim (Hind.); Simbi (Sans.); kidney bean.
Field 99.

This is a climbing perennial, or, under cultivation, an annual, common in India, where the seeds, which vary much in form and color, are employed as food. The beans from Tehran are black and brown, 15 by 10 mm., with a white hilum.

Dorema Ammoniacum Don (Umbelliferae)

وشا

Vashā (Teh.); Ushna ushek (Pers.); Kandal (Afg.); Samagh Hamama (Hind.); gum ammoniacum.

W.H.M.M. 150769.

The plant yielding this exudation is found in the desert regions of Afghanistan and Iran. The light colored gum-resin occurs in rounded tears, agglutinated masses, or cakes; it breaks with an opaque, shining or yellow conchoidal fracture, forming a milky emulsion with water. The drug has a faint, peculiar odor, and a bitter, nauseous taste. The gum is stimulating, expectorant, and laxative. Externally it acts as a resolvent, and is used as a plaster in asthmatic cases, and for indolent tumors and glandular swellings.

Doronicum Pardalianches L. (Compositae)

درونج اقربی

Darūnaj-i-akrabī (Teh., Ham.); Darvunedge eghrebi (Schl.); Doronic (Gr.); Doronicum Graeci (Ph. Pers.); doronicum root.

Achundow; Boiss. 3: 379; Makhjan-el-Adwiya; Ph. Ind. 2: 292; Kew Museum.

Field 168; K.B. 315.

This ancient drug is said to have come originally from Greece and Syria. *D. scorpioides* Lam. affords some supplies of the drug,

while *D. Falconeri* C.B.Cl., of the Himalayan region, has been identified as the origin of samples of the drug in India. It is a peculiar, knotted root, like the tail of a scorpion, and white, like alabaster. It contains inulin instead of starch, and is acrid and bitter. In Iran it is regarded as poisonous. It is useful in nervous depression, and is prescribed, according to the "Doctrine of Signatures," for persons bitten by scorpions and insects.

***Dracaena Cinnabari* Balf. (Liliaceae)**

خون سیاوش

Khūn-i-siyāvash (Isf.); Dam-el-akhwain (Ar.); Hira dukhi (Hind.); dragon's-blood resin.

Field 428.

Dragon's-blood is obtained from the isle of Socotra and Zanzibar, and is imported into India through Bombay. The resin, which exudes spontaneously from the ripening fruits, occurs in tears, the surfaces of which are covered by a dull red powder. When broken, the surface is glassy, translucent, and of a beautiful garnet color. The resin is soluble in spirit and is employed for coloring varnishes. In medicine, the resin is astringent, and is used to stop hemorrhage. Iranis make a paste of the powdered resin and water, which is applied to relieve pains in the legs and feet.

***Dracocephalum Moldavica* L. (Labiateae)**

باد رنجه بویه

Bād-i-ranjah būyah (Teh.); Badrish-bu (Tab.); Badrendj-bouyih (Schl.); the Persian name means "the scented remedy for flatulent colic"; the herb and seeds.

Achundow; Boiss. 4: 672; Ait.; Schl.; Ph. Ind. 3: 117; Cowan (Teh.); Gilliat-Smith (Tab.).

Field 198; K.B. 315.

Bād-i-ranjah būyah is an important drug in Iran, and has been variously referred to species of *Nepeta*, *Calaminta*, and *Melissa*, plants having the odor of balm. From Tabriz Gilliat-Smith sent seeds of the above mentioned species of *Dracocephalum* under the same vernacular name, thus confirming the identification of Schlimmer in 1874. The seeds are black, somewhat torpedo-shaped, 2 mm. long, with a white, V-shaped mark at the pointed end. They afford an opaque mucilage when soaked in water, and are used as a carminative and tonic. For another source of the drug see *Asperugo*.

Echinops persicus Stev. (Compositae)

شکر تیقال

Shakar tīqāl, "sugar of nests" (Teh.); Gol tighol of Royle; Tréhala manna.

Ph. Pers., 1681, 361; D. Hanbury, Journ. Linn. Soc., 16 Dec. 1858; Sci. Pa. 158-164; Schl.; Apping, 1885; Ebert, 1909; Tschirch, 1912.

Field 38, 32A; W.H.M.M. 150892; K.B. 315.

Tréhala is a sweet substance forming the cocoons of a beetle, occurring on the leaves and stalks of species of *Echinops* found in Iran, Turkey, and the Caucasus. The beetle is *Larinus maculatus* Fald. (Guldigul, Pers.), one of the Curculionidae. This insect forms a rough, chalky-looking nidus or cocoon, rounded-oval, 18 to 20 mm. long, yellowish white, rough on the outside and smooth within. The cocoon contains 15 to 23 per cent of a sugar identical with mycose. This peculiar secretion, known since the time of Avicenna, and described in "Pharmacopoeia Persica" (1681), is given for coughs and to relieve the respiratory organs.

Echium amoenum Fisch. & Mey. and other spp. (Boraginaceae)

گل کاو زبان

Gul-i-gāv-zabān (Teh.); the Persian name means "flowers of oxtongue"; flowers of borage.

Field 9, 30A; W.H.M.M. 150900; K.B. 316.

The drug under this name has been supplied by *Caccinia glauca* Savi and *Onosma macrocephala*. Schlimmer refers the drug to *Anchusa italica* and *A. hybrida*, and Dymock to *Trichodesma molle* DC. In Baluchistan the flowers are supplied by *T. indicum* R. Br., and in Sind by *T. zeylanicum*. It thus appears that Gul-i-gāv-zabān is a generic name applied to the blue flowers of several plants of the borage family. The blue corollas are 3 cm. long and 12 mm. wide at the throat, and funnel-shaped. They are considered to be a good cardiac, tonic, and demulcent.

Echium sericeum Vahl (Boraginaceae)

برک گاو زبان

Barg-i-gāv-zabān, "leaves of oxtongue" (Teh.); leaves of borage.

Field 225; W.H.M.M. 150764.

This sample is a mixture of leaves, stems, and flowers of the above plant. Other species of *Echium* are occasionally supplied. It is

said to be a tonic medicine and useful as an application for rheumatism and snake bites.

Elettaria Cardamomum Maton. (Zingiberaceae)

هل

Hil (Iraq); Arak or Erok Hail (Bagh.); Ilachi (Hind.): cardamom fruits.

Field 38A, 59 (Iraq).

There are two kinds of cardamoms sold in Iran and Iraq: the small or Malabar cardamom from the above plant, and the great or Nepal cardamom from *Amomum subulatum* Roxb. (q.v.). They are both imported, but the first kind is occasionally cultivated in Iraq in shaded gardens. As a masticatory and for flavoring food, as in curry, the Malabar or small cardamom is preferred by the natives, but the other kind, which is cheaper and of less delicate flavor, is used largely by sweetmeat makers.

Embelia Ribes Burm. (Myrsinaceae)

برنج کابلی

Birinj-i-kābuli (Teh., Isf.); Berengue Kaboli (Schl.); Baberang (Hind.); the fruits, Embely currants.

Fl. Br. Ind. 3: 513; Schl.; Ph. Ind. 2: 349.

Field 419; K.B. 316.

This shrub grows throughout India, where the berries have long been known as a medicine. Susruta described the anthelmintic properties of the fruits, which were given the Sanskrit name *Vrishanāsana*, "destroyer of enemy (worm)." The drug is referred to in all Mohammedan works of medicine, and its value in removing tapeworm (*Taenia*) in children and adults has been abundantly confirmed. The fruits are globular, dull red, with a 5-parted calyx, and stalked. The outer shell is striated from base to apex, the seed is horny and embedded in reddish brown afflorescence. In 1888 Warden separated the crystalline active principle, embelic acid. Brissemoret in 1907 showed this substance to be an oxyquinone.

Entada gigas (L.) Fawc. & Rendle (Leguminosae)

قرس کمر

Qurs-i-kamar, "nuts for loins" (Teh.); Gila (Beng.); Garabi (Hind.); the seeds.

Field 47.

This plant is a gigantic shrub, remarkable for its legumes, which are several feet long. It has been called Burmese tamarind. The seeds are more or less heart-shaped, flattened, about 2 inches in diameter, with a shining, brown surface. They are used by some hill tribes for washing the hair, as they contain saponin. Aitchison remarks that Kors-i-kamar seeds are exported from India to Iran and employed in medicine. In Tehran they are powdered and, mixed with yolk of egg, made into a plaster for pain in the back.

Equisetum ramosissimum Desf. (Equisetaceae)

قنطريون

Qantaryūn (Teh.); the herb, horsetail.

W.H.M.M. 150859.

The light green stalks of the horsetail with their brittle structure and acute edges appear by some mistake to have been intended to represent the centaury plant (*Erythraea Centaurium* Pers., Gentianaceae). They could not replace the pleasantly bitter centaury herb. *Dianthus anatolicus* Boiss. is called Kanturiyan in Iran, where it is also used as a substitute for the centaury of the European flora. The centaury, like other plants of the gentian family, is a domestic remedy for a general tonic.

Eremurus Aucherianus Boiss. (Liliaceae)

سريش سفيد

Sirish-i-safid (Isf., Teh.); commercial names: chiresh, sarish, siris, shirias; roots of the giant asphodel.

Field 1, 2 (Isf.); 80A, 240.

The roots of one or more species of asphodel, including *Asphodelus ramosus* L., are found in commerce in Iran and Central Asia, and are trade products in Mosul and Leh, either dried entire or powdered (Sirish-i-narm). They are exported from the Balad Sinjar district in northwestern Iraq to Syria (G.). The roots, whitish, twisted, hard, light brown, swell and soften and partly dissolve in water, forming a thick mucilage. Water added to the powder forms a glue used for cementing leather, in binding books, and for other industrial purposes. The green part of the plant is eaten.

Erysimum repandum L. (Cruciferae)

تخم خاک شیر

Tukhm-i-khāk-i-shīr (Ham.); Khakshir-talkh (Isf.); Khakechi (Schl.); Khubah (Ar.); Kashir (Bal.); the seeds.

Achundow; Ait.; Schl.; Boiss. 1: 189; Fl. Br. Ind. 1: 153; I.H.B. Field 150; K.B. 317.

This small, annual herb, hoary with close, appressed hairs, is frequent in Kashmir and Iran, and westward to Europe and West Africa. The seeds, with those of *Sisymbrium Sophia* L. and *S. Irio*, are exported into India from Iran under the name of Khākshīr. They are small, oblong, 1 mm. long, reddish or yellowish brown, smooth, and shining (not dull like those of *S. Sophia*). When placed in water, they become coated with transparent mucilage. The kernel is yellowish and oily and has the flavor of mustard. The seeds are given in fever and, in the form of a poultice, are used to relieve stomach pains.—They are often smoked to relieve eye diseases (H.F.).

Eugenia aromatica Baill. (Myrtaceae)

قرنفل

Qaranful, Qaranful-asward (Iraq); Karanaphal (Ar.); Laung (Hind.); cloves, the flower buds.

Field 43 (Iraq), 69A, 70A, 102.

Cloves, the well-known spice, consisting of the flower buds of a tree originally belonging to the Moluccas, are sold in all bazaars in the East. In modern medicine, cloves are used as a carminative and stimulant to relieve irritation of the throat, and the oil to relieve the pain of toothache. The oil, which is the most important constituent of cloves, is obtainable to the extent of 16 to 20 per cent. It is a mixture of a terpene and an oxygenated oil called eugenol.

Ferula galbaniflua Boiss. (Umbelliferae)

باريجہ

Bārījāh, Bariz, Rish-shar, Gavshira (Teh.); jāv or gāv means a cow, and shīr, milk; in allusion to the milky nature of the juice; gum galbanum.

Boiss. 2: 988; Schl. 295; Laufer 363; Ait.; Ph. Ind. 2: 152.

Field 131, 135; W.H.M.M. 150797; K.B. 317.

The galbanum plant is found in moist localities, as in the Badghis near Gulvan, where it grows in sandy soil. The stem is thick at the base, tapering suddenly and reaching a height of 4 feet. The stem, on injury, yields an orange yellow juice, which slowly consolidates into tears, and has a strong odor of celery. The sample from Tehran is said to have come from Kurdistan or Māzanderān. Galbanum is taken internally as a stomachic. Externally it is applied

as a plaster to sores and wounds. The drug contains resin 65, gum 20, and essential oil 10 to 20 per cent.

Ferula persica Willd. (Umbelliferae)

سک‌بینج

Sakbīnaj (Teh.); Saka-binaja (Ar.); Sek binedge (Schl.); Sagapenum gum.

Achundow; Ait.; Schl.; Laufer 366; Ph. Ind. 2: 161.

Field 163; K.B. 317; W.H.M.M. 150922.

Sagapenum is a fragrant gum-resin obtained from Laristan and Kerman. It is found in the market in tears or agglutinated into brownish yellow cakes with a persistent, alliaceous odor and acrid taste. It yields on distillation a volatile oil containing sulphur.

The drug has a local reputation as a plaster for rheumatism and lumbago.—Mixed with linseed oil it forms a salve for the relief of piles and pains in the back (H.F.).

Ferula Sumbul Hook. f. (Umbelliferae)

ریشه کلفس

Rīshah-i-kalafs, Sumbul, also the name for celery root (Teh.); musk or violet root.

Field 134.

This is a large, perennial plant of Samarkand. The root is thick and fusiform, light and spongy, transversely wrinkled, with corky, brown bark, and fibrous, whitish interior with resinous cells. The odor is strong and musk-like, and the taste bitter and aromatic. It is employed as a stimulant, nervine tonic, and antispasmodic, given in hysteria and nervous disorders.

Ficus Carica L. (Moraceae)

تین

Tin; common fig.

The edible fig grows wild in the mountain valleys of Kurdistan and in the foothills, and is also cultivated throughout Iraq as a fruit tree (G.).—The figs are usually sold strung on cords hung from the ceiling (H.F.).

Foeniculum vulgare Mill. (Umbelliferae)

ریشه رازیانه

Rīshah-i-rāziyānah (Teh.); the root of fennel.

باد يان سبز

Bādiyān-i-sabz, Tukhm-i-rāziyānah (Teh., Ham.); Badyan (Afg.); the fruits of fennel.

Post 356; Schl.; Ph. Ind. 2: 124; On the Commercial Varieties of Fennel, J. C. Umney, Pharm. Journ. 58 (1897) 225; I.H.B.

Field 16, 55A, 233, 413; W.H.M.M. 150771; K.B. 318.

Fennel is a stately, umbelliferous plant cultivated for its fruits in several parts of Europe and Asia. The fruits are frequently, in the bazaars, confounded with aniseed (*Pimpinella Anisum* L.), the Persian name for which is Badian, and Bādiyān-i-sabz is usually applied to fennel fruits. The taste is sweet and aromatic, and the fruits contain from 3 to 5 per cent of essential oil with anethol as the principal ingredient. J. C. Umney found the odor of Irani fennel nearer to anise than any other variety of fruit examined, the percentage of anethol being higher and fenchone comparatively low. Fennel is valued as a condiment and enters into mixtures given for dysentery and colds.

The root of the fennel plant is a rather important medicine in native practices, being to the present day esteemed as one of the five "opening roots" of the ancients, the other four being parsley, celery, asparagus, and butcher's broom.—Fennel roots, with *Carum copiticum* Benth. & Hook., are given as an infusion for flatus; and alone as an infusion for toothache and to relieve pains following childbirth (H.F.).

Fritillaria imperialis L. (Liliaceae)

گل سر نگون

Gul-i-sarnigūn (Teh.), "the bulbs of the topsy-turvy"; "the tubers of a plant, the flowers of which, according to the natives, hang upside down, considered rare in Afghanistan and highly valued as a medicine" (Aitchison). Another Persian name for this plant is Gul-i-shirper, "flowers of six feathers."

Boiss. 5: 189; Ph. Ind. 3: 498.

Field 178, 189; W.H.M.M. 150882; K.B. 318.

Crown imperial is common on the mountain slopes of Kurdistan. The drug consists of broken pieces of thick, whitish corms, without odor or taste. The starch is oval and regular. A toxic alkaloid has been separated from them by Fragner (1888). The corms of this plant are valued as a medicine in the Far East, chiefly for chest complaints and toothache. Regarding the Irani drug, it is said,

"When a woman has a child, a paste is made from it and put on the stomache to reduce pain" (C.).

Fumaria parviflora Lam. (Fumariaceae)

شاطرہ

Shātarrah (Teh., Isf.); Tukhm-i-shātarrah (Ham.); Shahtarrah, "royal herb"; Tarrah, "potherb" (Pers.); the plant.

Achundow; Schl.; Boiss. 1: 135; Fl. Br. Ind. 1: 128; I.H.B.; Ph. Ind. 1: 114.

Field 13 (Isf.), 406, 426; W.H.M.M. 150770; K.B. 318.

The fumitories are medicinal herbs employed throughout India, Afghanistan, and Baluchistan. The herb and fruits are both used. The herb occurs in broken fragments of stems and leaves with a slightly acid and astringent taste. The fruits are green, globular, the size of a pinhead, apiculate, rugulose on the surface, and one-seeded. They have scarcely any odor and the taste is slightly acrid and astringent. The plant contains fumaric acid and the alkaloid fumarine. Shātarrah is highly esteemed by Mohammedans in India; it is said to purify the blood and act as a laxative and diuretic. —In Iran it is prepared like tea to relieve pains in the back in pregnancy (H.F.).

Fungi, see *Agaric* and *Polyporus officinalis*.

Gentiana lutea L. (Gentianaceae)

جوتیانا

Jūtiyānā (Isf.); Juntiyana (Duk.); gentian root.

Field 435.

European gentian root is prescribed with the fragrant fruits of the cow-parsnip to correct its bitterness. The root of *Gentiana Olivieri* Griseb., growing on the mountains in western Iran, is occasionally met with in the bazaars, and represents the Eastern gentian.

Glossostemon Bruguieri Desf. (Sterculiaceae)

بوقناق

Būqnāq (Teh.); Erok orab kuzzi (Iraq); Arab qosi (Turk.); Mughat (Egy.); the root.

Field 83A; W.H.M.M. 150747.

This is a large, cabbage-like, perennial herb with broad leaves and small, reddish brown flowers. The root is sold in the bazaars of

Egypt and Baghdad in a powdered form and employed by Coptic and Arabian women as a strengthening medicine. Before 1914 it was exported in considerable quantities, chiefly to Egypt, as an aphrodisiac. A decoction of the root is sometimes used at Baghdad as a cough cure (G.).

Glycyrrhiza glabra L. (Leguminosae)

ریشه اصل سوس

Rīshah-i-asl-i-sūs (Teh.); Bekh-sus; the root.

رب سوس

Rubb-i-sūs, Asal-alsus; the sweet extract; licorice.

Achundow; Ait.; Boiss. 2: 202; Post 277; Schl.; Ph. Ind. 1: 491.

Field 243, 259; K.B. 319.

The licorice plant is a characteristic and common shrub in the Badghis and Khorasan at an altitude of about 2,000 feet, and occurs also in Baluchistan. The annual shoots grow to 4 feet from enormous underground rootstalks, which are sometimes used as fuel. The nomads at Yezd prepare an extract from these roots. India obtains market supplies of the root and extract from Iran and Sīnd; it has been suggested that the plant might be cultivated in the North-Western Frontier Province. Throughout Asia, licorice root and its extract, from time immemorial, have been used for cough and chest complaints.

—Licorice root is also given to relieve acute indigestion from eating fruit (H.F.). The plant is said to yield an aphrodisiac (G.).

Gossypium sp. (Malvaceae)

قطن

Cotton (Qutn, Ar.) is the hair-like cells clothing the seeds of the cotton plant. Specimens of cotton and seeds presented to Field Museum by the Rustam Agricultural Experimental Farm at Hinaidi, Iraq, are:

G. herbaceum L. Iraqi or Indian cotton (Qutn Iraqi); probably indigenous or at least cultivated for many centuries. (Field 6A.)

G. barbadense L. Sea Island cotton. (Field 2A.)

G. hirsutum L. "Mesowhite" (Qutn Amrikani). A derivative of the long-staple American upland cotton. (Field 38 [Iraq]; 8A, 10A, 13A.)

G. mexicanum Tod. Mexican cotton introduced into India in 1804. The seeds yield a copious, woolly floss. (Field 13 [Iraq]; 1A.)

At Rustam Farm the following varieties of cotton are also grown:

- (a) Rustam No. 65. Field 3A. Origin Iraq.
- (b) Rustam No. 124. Field 5A, 9A. Origin Punjab, India.
- (c) Mosul White. Field 4A. Origin Mosul, Iraq.
- (d) *G. peruvianum*. Ish-hony. Field 11A, 12A. Origin Egypt.
- (e) Rustam No. 138. Field 7A. Origin Acala.

Guest (p. 39) records the following information: "*Gossypium* (Malvaceae). Cotton. Qutn (Ar.), Pambuq (Turk.), Lukah (Kurd.), Pambu (Kurd.).

"Iraqi or Indian Cotton, *G. herbaceum* L. (Qutn Iraqi), a well-known, short-stapled type, is probably indigenous or has at least been cultivated in Iraq for many centuries. It is still grown to some extent as a summer crop, especially on the northern plains where springs or streams provide irrigation water. The lint is used chiefly for stuffing. It is the local practice to pick this type of cotton with the boll intact, the dry boll and other rubbish being removed later.

"After the War the Department of Agriculture tried many foreign varieties of cotton and eventually issued seed of 'Mesowhite,' a derivative of the long-stapled American Upland cotton, *G. hirsutum* L. (Qutn Amrikani). A ginnery was erected by the British Cotton Growing Association, who did much to encourage this crop. The cultivation of Mesowhite cotton as an irrigated summer crop rapidly became popular in lower Iraq and after ten years (in 1928) the annual export of cotton exceeded 5,000 bales of 400 pounds each. Since that year the size of the crop has fallen off very rapidly, chiefly owing to the slump in world prices which has discouraged the local farmers. In 1932 the export of bales of cotton from Iraq amounted to only about four hundred. One or two other varieties of American cotton, such as Acala, have done well in trials at Rustam Farm; this is a cotton inferior to Mesowhite but gives a higher yield and ginning percentage.

"Egyptian cottons (Qutn Misri) have also been tried but have not proved successful under local conditions."

***Gypsophila paniculata* L. (Caryophyllaceae)**

الصابونية

El-sābūniyeh (Ar.); Zuleh (Ham.); Saosafid, Bekh (Ait.); Kundur, Kundusch (Achundow); soap-root.

Ait.; Post; Boiss. 1: 542; Ph. Ind. 1:155.

K.B. 319.

This is a shrubby plant of northern Iran, Afghanistan, the Caucasus, and Turkestan, 3 to 4 feet high, with numerous stems springing from the perennial rootstock. The underground rootstocks are collected and used as soap for washing the hair and clothes. The Irani drug is no doubt a substitute for the older Roman and Egyptian *Struthium*, the root of *G. Struthium* L. of southern Europe. The roots contain from 6 to 16 per cent saponin.

Halimodendron argenteum Fisch. (Leguminosae)

Field 14, 31 (Iraq).

Halimodendron is a thorny shrub found in Iran, the Caucasus, and Central Asia. Fruits of this plant were collected without a local name, from Yezd-i-Khast between Isfahan and Shiraz. The thorns are used in native surgical operations. Inflated pods, 2 cm. long and oblique, are brown, and contain two or three seeds like chick peas.

Helianthus annuus L. (Compositae)

افتاب کردن

Aftāb gardan (Teh.); Ward-ash-shams, Shams-wa-qamar (Iraq); Qunah baqan (Turk.); sunflower seeds.

Field 122 (Teh.), 72, 73 (Iraq).

Two kinds of sunflower seeds are represented in these collections: black, ovate-elongate, 12 by 6 mm.; and white, smooth, broader achenes, 12 by 7 mm. There is a good market for these seeds, which are used for human consumption and for bird food, and yield by expression an oil for cooking purposes. Many tons of the seeds are produced annually in the U.S.S.R.

Helicteres Isora L. (Sterculiaceae)

بهن بیج

Bahman-i-pīch, Pachman-i-puh (Teh.); Kisht bar Kisht (Pers.); Pechak, Marorphali (Hind.); Avartin (Sans.); the Persian and Sanskrit names signify the furrows on a ploughed field; the spiral fruits.

Ibn Baitar; Achundow; Fl. Br. Ind. 1: 365; Ph. Ind. 1: 231.

Field 137; K.B. 320.

The East Indian screw tree occurs in dry forests throughout central and western India and in Ceylon, Java, and northern Australia. The spirally curved fruits are sold in all Indian bazaars and

in more northern countries. The fruit is composed of fine, slender, angular carpels twisted like corkscrews, which together form a cone 3.5 to 5 cm. long. The carpels are pubescent and greenish brown, and each one contains a single row of dark brown, angular seeds.

The drug has demulcent and slightly astringent properties, and is employed as a medicine for dysentery and for griping of bowels and flatulence in children.

Heracleum persicum Desf. (Umbelliferae)

گل سپر

Gul-i-sipar (Teh.); Gul-i-parr (Isf.); Goleper (Kerm.); Giafari (Schl.); the fruits.

Schl.; Post; Boiss. 2: 1044.

Field 434; W.H.M.M. 150779; K.B. 320.

This species of cow parsnip is indigenous to the moist valleys of the Elburz Mountains, and is related to *H. pubescens* M.B., of a wider range. Boissier refers the plant Goulpere to *H. lasiopetalum*. The fruits, which are sold as a spice and used in pickles, are ovate-oblong, villous on the back, the margin aculeate, the dorsal vittae thick and clavate, reaching to two-thirds the length of the mericarp. While some of these plants are used medicinally and for food, other species in America and Europe are poisonous and produce erysipela-tous inflammation (Cormerin, "Des Plantes Vénéneuses," 1887).

Hibiscus cannabinus L. (Malvaceae)

جل جل

Jiljil (Iraq); Hab-el-zalim (Ar.); Palsan (Hind.); Ambari (Duk.); the seeds.

Field 61 (Iraq).

The Deccan hemp plant is grown in western India and the tropics. The seeds are dull grayish brown, triangular or kidney-shaped, 5 by 3 mm. They contain an oil useful for culinary and lubricating purposes. The seeds are used in medicine and as cattle food.

—*H. Trionum* L., Qunnab, called Jiljil near Basra, yields a bast fiber resembling that of the Deccan (H.F.).

Holarrhena antidysenterica Wall. (Apocynaceae)

میوه زبان گنجشک

Mivah-i-zabān-i-gunjishk, Tukhm-zabān-i-gunjishk-i-talkh, "the seeds of the bitter sparrow's tongue" (Pers.); Lizan ul asafir (Achundow); Indrajau (Hind.); Estrefanthus; the seeds.

Ph. Ind. 2: 392; Pyman, Journ. Chem. Soc. 1919; Fl. Br. Ind. 3: 645.

W.H.M.M. 150793; K.B. 320.

This small, deciduous tree is found in the tropical Himalayas from the Chenab westward, and throughout the drier forests of India to Travancore and Malacca. Samples of the seed came from Hamadan and Tehran, showing that the Indian drug is well established in Iran. The seeds are narrowly linear-oblong, glabrous, and brown, about 12 mm. long. They have a bitter taste due to the presence of the alkaloid wrightine (conessine), which acts like emetine. The seeds are reputed to have tonic and aphrodisiac properties.

Hordeum vulgare L. (Gramineae)

جو سفید جو سیاه

Jau, Jōyi safid (white), Jōyi siyāh (black) (Iraq); Jao (Sind); Jū (Kurd.); Jav (Hind.); barley.

Field 59, 71, 275; 11, 32, 44, 46, 70 (Iraq).

Barley is the most widely cultivated grain and forage crop throughout Iraq. The variety *hexastichon*, or six-rowed barley, has been found in the earliest Egyptian monuments and is the variety most frequently grown in India and Iraq. Early sown barley provides the greater part of the winter grazing in the irrigated areas; horses and other animals are also fed on the grain. Local barleys yield well, but are generally unsuitable for malting. The collection includes specimens of white and black barley, the varieties *distichon*, *hexastichon*, and *erectum*, and the Alleidum barley of Iraq. Pearl barley is imported from Europe and is obtainable in most Eastern bazaars. Mason quotes a saying in Iran, "What has disease to do with men who live upon barley-bread and buttermilk?"

Guest (p. 46) gives the following information concerning barley:

"*Hordeum* (Gramineae). Barley grass, Barley. Sha'ir, etc.

"*H. murinum* L., Wall Barley or Barley grass. Sha'irah, Shuwairib, Sha'ur, etc. Small tufted annual grass with a flattened inflorescence like a miniature barley. Widely distributed in fields, on channels and ditches, by waysides and in waste places. March-April. In maturity it is a fodder plant of rather low feeding value, though the young growth is nutritious. The seeds are barbed and the awns serrated; hence the mature plants are likely to injure the tender parts of stock.

"*H. bulbosum* L. Abu Suwaif, Gizar Gia (Kurd.), etc. A tall perennial barley grass with a bulbous root. A common weed in cereal fields on the upper plains and in the valleys of Kurdistan, often projecting conspicuously above the ears of the crop. March-May. It is a useful fodder plant sometimes preserved for winter feeding. Children often eat the bulbous roots.

"*H. spontaneum* K. Koch. Tall grass similar to the above. Common on the rocky slopes of Jebel Sinjar and other hills. April-May.

"*H. sativum* Pers. (*H. vulgare* L.). Sha'ir, Arpā (Turk.), Jū (Kurd.). The most widely cultivated grain and forage crop throughout Iraq; with wheat, rice, and dates it forms the staple food of the majority of the inhabitants. Early-sown barley provides the greater part of the winter grazing in the irrigated areas; horses and other animals are also fed on the grain. The climate is unfavorable for the slow ripening which is necessary to produce good malting barley, since the summer comes on very suddenly, almost before the spring is over. Two-rowed barley (var. *distichon*) is generally known as Sha'ir Abū Sūwaif or Sha'ir Abū Sikkatain; six-rowed barley (var. *hexastichon*) as Sha'ir Sparqalān."

—In the collections of the Rustam Agricultural Experimental Farm at Hinaidi near Baghdad, Iraq, the following varieties of barley are represented:

- (a) *H. sativum* dest. erect., *nigrum*. Sha'ir Abū Sūwaif. Rustam No. 127. Field 23A. Origin Al Mahmudiya, Iraq.
- (b) *H. sativum* Pers. (*H. vulgare* L.) *albidum*. Rustam No. 128. Field 24A. Origin Biskra.
- (c) *H. sativum distichon*. Chilian barley. Rustam No. 160. Field 25A. Origin Australia.
- (d) *H. hexastichon albidum*. Circlan barley. Rustam No. 217. Field 22A. Origin Iraq.
- (e) *H. sativum albidum*. California barley. Rustam No. 150. Field 20A.
- (f) *H. sativum albidum*. Sha'ir. Rustam No. 218. Field 21A. Origin Iraq. (H.F.)

Hyoscyamus reticulatus L. (Solanaceae)

بزر بنج

Bazr-i-banj (Teh., Ham.); Kohi bang (Bal.); Banj barri (Iraq); Benj (Ar.); Bango (Port.); henbane seeds.

Ait.; Boiss. 4: 295; Schl.; Post; Ph. Ind. 2: 626.

Field 217; K.B. 321.

This species of *Hyoscyamus*, as well as *H. muticus* L. and *H. pusillus* L., is found wild in Iran and Syria. Aitchison observed that goats and sheep grazed on henbane plants without apparently bad effects, and the shepherds did not look upon these plants as poisonous. The seeds, however, are regarded by native physicians to be as poisonous as opium; they are exported from Iran to India. Henbane seeds are reniform, laterally compressed, grayish brown, with the testa finely reticulated. The taste is oily, bitter, and acrid; they contain the poisonous alkaloid, hyoscyamine.—The smoke of the seed is inhaled for toothache (H.F.).

Hyssopus officinalis L. var. **angustifolia** Boiss. (Labiatae)

گل پونه

Gul-i-pūnah (Teh.); Zupha-e-yabis (Ar.); Jupha (Hind.); hyssop, the herb.

W.H.M.M. 150723.

The true hyssop is a small, aromatic plant of Iran, Sind, and southern Europe. It is from 6 to 10 inches high, with a slender, square stem, hairy flowers in oblong spikes, of a brownish or bluish purple color and with the odor of hay. The seeds are oblong, three-angled, dark brown mottled with a red tint. The plant is given as a stimulant, carminative, and diaphoretic.

Illicium verum Hook. f. (Magnoliaceae)

بادنجان خطائی

Bādiyān-i-khatā'i, "anise of China" (Pers.); from Tehran.

Schl.; Ph. Ind. 1: 41.

Field 190; W.H.M.M. 150715; K.B. 321.

The star anise of commerce is obtained from trees growing in South China and Indo-China. Star anise was a new medicine and spice in Persia a hundred years ago, but the fruits and oil are now shipped regularly to India from China, and reach Iran via Bombay. The star-shaped fruits, composed of eight brown, radiating, boat-shaped carpels, vary from 3 to 3.5 cm. in diameter. They contain about 5 per cent of essential oil, consisting of solid and liquid anethol. The fruits and oil are stomachic, given to relieve cough and lung affections, and are used in confectionery and for seasoning food.

Indigofera Roxburghii Jaume (Leguminosae)

عَدَس تَلَخ

'Adas-i-talkh (Teh.); Bin-i-talkh (Isf.); the seeds.

Field 442; W.H.M.M. 150872.

These seeds are red in color, polished, flattened, oblong, 4 by 2 mm., very hard, and bitter.—They are given to relieve stomach pains (H.F.), and are similar to seeds of an allied plant, *I. trifoliata* L., prescribed in Guzrat as a restorative.

Indigofera tinctoria L. (Leguminosae)

رَنَك کَرْمَانِي

Rang-i-kirmānī, Nasābīdah-i-kirmanī(?), Rang-i-sābīdah, Rang-i-vasmah (Teh.); Wasma (Punj.); Nil (Hind.); leaves of the indigo plant.

Field 112A, 152; W.H.M.M. 150762, 150790.

It is of historic interest to note that the old name for indigo leaves in the Punjab, Iran, and Turkey is Wasma, the name formerly used for woad, the dye obtained from *Isatis tinctoria*, and used by the early Britons. *Isatis* is indigenous to the Kuram Valley, where it is called Ranjowah or cat's filth. Indigo was known in Avicenna's time, and India has cultivated and produced the dye as a leading industry for several generations. The leaves, like henna, are sold in both coarse and fine powder, and used chiefly as a cosmetic for coloring the skin.

Inula Helenium L. (Compositae)

رَأْسِ هِنْدِي

Ra's-i-hindī, Ghaza gouzanah (Teh.); Anduz (Ham.); Pil gush, "elephant's ear"; Rasan, Rasna of the Hindus; Andiz otu (Turk., see Boiss. 2: 186); Zanjabil chami, "ginger of Damos"; Zanjabil-ishami, "Syrian Costus"; Année (Fr.); Helenion (Gr.); Enula Campana (Med. Lat.); elecampane root.

Ph. Pers.; Schl.; Boiss.; Pharmacog. 340; Ph. Ind. 2: 259.

Field 222; K.B. 322.

Elecampane root was an ancient medicine among the Greeks, and its use spread to other parts of Europe and to Asia. The root is hard and horny, grayish brown in color, paler within. Crystals are seen in the interstices of the wood in old commercial samples. The root, which has an agreeable, aromatic odor, and a warm, bitter

taste, is given for bronchitis and tuberculosis, and as a general aromatic tonic.—A small piece is eaten to reduce phlegm (H.F.).

***Ipomoea hederacea* Jacq. (Convolvulaceae)**

تخم نیلوفر

Tukhm-i-nilūfar (Teh.); Habb-el-nil (Ham.); Tukhm-i-nil; Kal-adanah, "black seed" (Hind.); pharbitis seeds.

Ait.; Schl.; Fl. Br. Ind. 4: 197; Ph. Ind. 2: 532; B.P. 1914.

Field 44; W.H.M.M. 150875; K.B. 322.

The above plant grows throughout India; the flowers are blue, hence the name Nil, applied also to the water lily. The seeds are blackish, forming the quadrant of a sphere, about 5 mm. long, with a minute protuberance at the upper end; they have a longitudinal, dorsal groove, and dark brown hairs on the hilar depression. The action of these seeds is cathartic, due to the presence of an acrid resin. They are locally considered poisonous.

***Ipomoea Turpethum* R. Br. (Convolvulaceae)**

ترید

Turbud (Teh.); Turbad (Leh); Triorit, Triputa (Sans.); turpeth root.

Field 223; W.H.M.M. 150907.

The plant is a native of India, Ceylon, and the Malay Archipelago; the root, from earliest times, has been a valued medicine in the East. Turpeth occurs in pieces of varying length, from 10 to 20 cm. long and 1 to 2 cm. wide, deeply wrinkled longitudinally, and of a dull gray or brown color. The odor is slight, the taste nauseous but slowly developed. The root contains from 5 to 10 per cent of resin, partly soluble in ether. Turpeth is a cathartic, used in lum-bago and kidney trouble, given either alone or in combination with other purgatives.

***Iris spuria* Pall. (Iridaceae)**

بیج بنفشه

Bikh-i-banafshah, Rīshah-i-arīsa (Teh.); Irisha (Ind. bazaars); "violet root," the name is a corruption of the Greek; orris root, root of graveyard iris.

Schl.; Boiss. 5: 126; Ph. Ind. 3: 451; I.H.B.

Field 132, 239; W.H.M.M. 150759, 150915; K.B. 323.

Violet root or orris root was recognized in ancient Greece and Rome and has long been known throughout the East, where the root is used for its perfume and as a medicine. The drug is obtained from more than one species, and the specimens differ in their properties and aroma. Aitchison says the rhizome called Orisa in Afghanistan is brought from Bijnort to the Meshed market. Bombay is supplied with orris root from Iran and Kashmir, and some of the Irani root comes from Kurdistan. A specimen of Banafshah from Iraq (Field 23, Iraq) was a well-trimmed sample of orris root from Europe (*I. florentina* L.).—It is given as an infusion to relieve headache, and is prescribed for excessive labor pains (H.F.).

Jateorhiza Columba Miers (Menispermaceae)

کلمبو

Kulambū (Teh.); Kalamb-ki-jar (Hind.); calumba root.

Field 209; W.H.M.M. 150780.

Calumba root, obtained from climbing plants growing in the forests of the Zambezi in Portuguese East Africa, has established itself as a drug in nearly every part of the world. The dry root is met with in circular or oval, transverse slices about 1 to 2 inches in diameter. The taste is very bitter, aromatic, and mucilaginous. Calumba is employed as a stomachic and bitter tonic. It contains no tannin, so can be combined with iron salts.

Juglans regia L. (Juglandaceae)

کردو

Girdū (Teh.); Charmaghy (Pers.); Jawz-i-rumi (Afg.); Joz, Goz (Turk.); Guzk (Kurd.); Akhrot (Hind.); the walnut tree.

Field 270.

The walnut is a handsome tree in Iran, Kashmir, and China. The leaves, bark, nuts, and oil are used in medicine. In Iraq cultivated walnut trees, giving nuts with a soft shell, are called Chagzi, those with a hard shell, Metahk. The nuts are somewhat smaller than those of Europe.

Juniperus excelsa Bieb. (Coniferae)

ابهل

Abhil, Aabb-el-harar (Teh.); Harhār-kohī (Afg.); Hab-el-a'ra'r (Ind. bazaars); juniper berries.

Field 248; W.H.M.M. 150876.

The juniper berries sold in Tehran are said to be collected in the Elburz Mountains. The fruit is a galbulus, gray-brown, 8 mm. in diameter, apex with a triradiate scar; it contains three hard, triangular seeds, with large oil glands and yellow resin. The odor is like turpentine, and the taste sweetish. The fruits are a well-known drug in India, where they are imported from the West. They and the oil have a diuretic action and are administered for dysmenorrhea and intestinal indigestion. The leaves are used as incense in Khorasan.

Lactuca sativa L. (Compositae)

تخم کاهو

Tukhm-i-kāhū (Teh.); Bazrul khasa (Ar.); Kahu-khaskabija (Hind.); lettuce fruits.

Field 210; W.H.M.M. 150740.

The "seeds" or fruits are gray, elongated, 4 by 1 mm., ribbed longitudinally, pointed at the apex; the odor is slightly aromatic and the taste bitter. An infusion of the fruits is given in fevers—typhoid in particular (H.F.).

Lettuce opium or lactucarium, mentioned in old pharmacopoeias, was a concrete, milky juice obtained by bruising the stems. This drug now seems to have disappeared from the markets.

Lagenaria vulgaris Ser. (Cucurbitaceae)

تخم کدو قلیانی

Tukhm-i-kadū qalyānī (Teh.); Ghya ke bij (Hind.); seeds of the bottle gourd.

Field 121, 211.

This is a climbing plant found wild in India, the Moluccas, and Ethiopia (Abyssinia). In cultivation the fruit assumes many forms, the best known of which are the pilgrim's gourd, trumpet gourd, and the calabash.

The seeds are nutritive and diuretic and constitute one of the five cucurbitaceous seeds; see *Citrullus vulgaris* Schrad.—They are given as an infusion in typhoid (H.F.).

Lallemantia iberica F. & M. (Labiateae)

بالنکو شهری

Bālingū shahrī (Teh.); Gara za'arak, "little black seeds" (Tab.). W.H.M.M. 150898.

The seeds of this plant are larger than those of *L. Royleana* Benth., being 5 by 1.5 mm., brownish in color, and with a V-shaped mark at the apex. They slowly become coated with mucilage when placed in water. The plant is one of the potherbs of Iran.

Lallemantia Royleana Benth. (Labiatae)

بالنکو شیرازی

Bālingū (Ham.); Bālingū-shirāzī (Teh.); seeds.

Boiss. 4: 674; Ph. Ind. 3: 90.

Field 4; 15 (Iraq); W.H.M.M. 150901; K.B. 323.

This plant is found throughout Iran, Baluchistan, Afghanistan, Turkestan, and northern India.

The seeds are black, narrowly oblong, 3 by 1 mm., smooth, angled on the inner side, arched on the other, a white spot at the narrow end or umbilicus. When soaked in water they immediately become coated with an opaque, gray, tasteless mucilage. The seeds are used for coughs.

Languas officinarum Burkill (*Alpinia officinarum* Hance)
(Zingiberaceae)

خولنجان

Khūlanjān (Teh.); lesser galangal.

Schl.; Ph. Ind. 3: 437; Sci. Papers 370.

W.H.M.M. 150877; K.B. 324.

This plant is indigenous to the Chinese island of Hainan, and is cultivated on the neighboring coast of Kwangtung and in Siam. The rhizome is an ancient spice and medicine of the East and is occasionally brought to Europe. The root is about 5 cm. long and less than 1.3 cm. in diameter, often branching, of a rusty brown color, longitudinally striated, and transversely marked with remains of leaf sheaths. The odor is aromatic and the taste hot and spicy. Galangal root is used as a condiment and is given as a stomachic and for rheumatism.

Lathyrus sativus L. (Leguminosae)

حرتومان

Hurtāmūn (Iraq); Kesari (Hind.); Lakh (Bom.); Lang (Guz.); the chickling vetch and seeds.

Field 74 (Iraq), 65A.

This annual herb is indigenous to the region that extends from the Caucasus to northern India, and is frequently cultivated in India and Iraq as a winter crop. The seeds are used for human consumption and for feeding animals; as a green manure or forage crop it surpasses other vetches. It has for a long time been known that a form of paralysis named Lathyrism is believed to result when this pulse is eaten continuously for some length of time. Guest, however, states that there is no evidence that its harmful nature has ever been recorded in Iraq.

Lavandula dentata L. (Labiatae)

اسطوخودوس

Ustūkhūdūs (Teh.); Osthoukhodouce (Schl.); the Persian name is derived from the Greek; flower heads.

See paper on this drug by I. H. Burkill in the Journ. As. Soc. Bengal, N. S., V, No. 3, March, 1909, 67-71; Ph. Ind. 3: 93; Boiss. 4: 540.

Field 18; W.H.M.M. 150737; K.B. 324.

These are the flower heads of a species of lavender sold in Tehran and brought from Shiraz. They constitute an ancient drug used by the Greeks and referred to by Arabian and Persian physicians. The name has also been applied to *L. Stoechas* L., the Staechus of old works on materia medica. The flowering spikes have the odor of rosemary and camphor, and yield an essential oil containing dextro-camphor and dextro-fenchone. In the form of an infusion the drug is given for catarrh and malaria; it is also used for washing wounds and eruptions.

Lawsonia alba Lam. (Lythraceae)

حناء برک

Hinnāy-i-barg (Teh.); Hinna (Iraq); Rang-mehndi (Hind.); Camphire (Syr.); henna leaves.

Field 74, 188, 220; 19, 45 (Iraq); W.H.M.M. 150819, 150863.

The henna plant is cultivated throughout India on account of its leaves, which yield the henna dye, and as a garden hedge plant. They are sold in the shops in two forms: (1) the broken leaves, and (2) the leaves called "Rangh" reduced to fine powder and mixed with a small quantity of mustard oil. The principal value is as an article of the toilet, for staining the finger nails, hands, and feet a dull orange color, and for dyeing the hair bright red. The use of henna

as a cosmetic dates from very ancient times; it is practiced by Mohammedan women, and has become a vogue in Europe. Staining the finger nails with henna to make them resemble hazelnuts is called "funduq bastan." Henna is also used as an external application for skin diseases, blind boils, and leprosy.—It is painted on the pubic region for stoppage of bladder (H.F.). The seeds contain about 10 per cent of fixed oil.

Lecanora esculenta Eversm. (Parmeliaceae)

شیر زاد

Shīr-zād (Teh.); Chir zadi, Agalactie (Schl.); the lichen.

Holmes, Manna, Chem. & Drugg. 92: 25 (1920).

Field 418; W.H.M.M. 150752; K.B. 325.

This manna lichen is abundant in North Africa and western Asia, and locally in the desert of Seistan. It varies from the size of a pea to a small nut, clear brown or whitish; the interior is soft, white, with interlacing hyphae and crystals of calcium oxalate. There is a tendency for the thallus to develop excrescences of a nodular form which easily become free and drift about with the wind in the desert. Schlimmer gives references to the use of this lichen as food from the time of Alexander the Great. It contains lichenin. Its nutritive power is very low. The name of the drug means "milk begetting," and it is employed to increase the flow of human milk.

Other lichens referred to in the Field collection:

Usnea sp. (28A), a lichen of Iraq and Iran, called Lihayat-as-shāyib, or "old man's beard." This is mixed with flour in bread-making, and a decoction is sometimes taken to correct bad breath.

An Alpine lichen (87A) called Lachyat-as-sheikh. This is used as a perfume. Perfumed lichens have been observed in the genera *Evernia*, *Ramalina*, and *Zobaria*.

Boucerosca Aucheri(?), a lichen called Mārmūt, used by Brahuīs in languor and oppression (Ait.). Pāla-mangy and Māhriz are the Kashmir names of two lichens employed to dye the nails and hands as substitutes for henna (Ait.). One of these is probably *Squamaria chrysoleuca* Sm.

Lens esculenta Moench (Leguminosae)

نيسك

Nisik (Kurd. in Iraq); Adas (Turk.); Masūr (Hind.); the lentil.

Field 48, 66, 68 (Iraq); 105A.

The lentil is an excellent fodder or grazing plant, affording a most nutritious pulse. As an article of food it has been known from the most ancient times; specimens have been discovered in the tombs of Egypt dated 1500 B.C., and are shown in the Wellcome Historical Medical Museum. Lentils are used as food whole or split (when they are called in India "Dall"), and in the form of flour.—A specimen in the American School for Boys, Baghdad, is labeled "Adas mar, lentils ground and taken by women to facilitate parturition" (H.F.).

Lepidium Draba L. (Cruciferae)

میچہ

Muchchah (Isf.); Bajindak (Afg., Hind.); Buski (Bal.); hoary cress.

K.B. 325.

The hoary cress is a weed of cultivation distributed westward to Europe. In Tabriz the young shoots are used as a salad or potherb under the name of "Khili-wili." The seeds, smaller than those of *L. sativum*, are oval and dark brown. Seven or eight seeds are given as a dose for flatulence.

Lepidium sativum L. (Cruciferae)

تخم شاهی

Tukhm-i-shāhī (Teh.); Tukhm tartizak (Isf.); Halim (Hind.); Asalia (Bom.); Tara tezak (Afg.); cress seed.

Ait.; Schl.; Ph. Ind. 1: 120; Boiss. 1: 354.

Field 31, 448; W.H.M.M. 150717; K.B. 325.

Garden cress is a native of Iran, and is widely distributed as a cultivated plant eastward to Tibet. The seeds are exported as a drug from Iran to India, and westward to Europe. They are light brown or reddish brown, oblong, 3 by 1.2 mm., with a depression on the inner margin, and a white spot at one end, have a pungent, cress-like taste, and become coated with transparent mucilage when soaked in water. They are tonic, aphrodisiac, and diuretic.

Linum usitatissimum L. (Linaceae)

تخم بزرک

Tukhm-i-bazrak, Bazrak (Ham.); Basarak Katrin, "little seed of flax" (Pers.); Tukhm-i-katan (Ait.); Bazr ul Kattan (Achundow);

Bizre Kattane (Schl.); the names for linseed in India are Alsī, Atasī, and Alashi; linseed.

Ph. Ind. 1: 239.

Field 21; 63, 67 (Moroccan and River Plate seeds from Iraq); W.H.M.M. 150809, 150920; K.B. 326.

Aitchison informs us that in Afghanistan the flax plant and seed are known as Zagher; the oil of the seed as Roghan-i-zagher; the fiber and linen cloth as Katan or Katun. The plant is cultivated in Turkestan for the oil of its seeds, but, as in India, the fiber is not collected. In Iraq Moroccan linseed has been distributed in considerable quantities as Indian varieties have been severely attacked by rust disease (G.). The oil is valued for various industrial purposes and the seeds are eaten as sweetmeats.—Boiled with *Althaea* sp., the seeds are used as a poultice for boils (H.F.).

Lolium rigidum Gaud. (Gramineae)

کل چمن

Gul-i-chaman (Teh.); Ziwan (Iraq); rigid rye grass; seeds.

W.H.M.M. 150705.

This is a tufted annual grass grazed by sheep and other animals. It is related to the darnel grass (*L. temulentum*), "Jamdar," which is regarded as an obnoxious weed, since its seeds are sometimes infected by an ergot fungus generating a narcotic poison. The use of the seeds sold in Tehran is not known.

Loranthus Grewinkii Boiss. and Bunge (Loranthaceae)

کشمش کولی

Kishmish-i-kūlī (Teh.); Kishmish-kawali (Ind. bazaars); Dibk (Ar.); mistletoe berries.

Field 139; W.H.M.M. 150756.

These fruits are called raisins of Kawali, Kawali being the name for gypsies in Iraq and Iran. Le Bode in his "Travels in Lauristan and Arabistan" mentions his being shown in the forests of the Zagros Mountains, on the road from Kermanshah to Baghdad, a fruit called by the natives Angur-i-kauli (Kawali) or grapes of Kauli, a parasite on the oak. The dried berries are rounded, 8 mm. in diameter, soft, dark brown, and shriveled, and have one seed. They are mawkish in taste, containing a form of caoutchouc which can be drawn out in threads. The author of the "Makhzan-el-Adwīya"

says the properties of the berries are resolvent and laxative.—The dried berries mixed with water are used as a depilatory (H.F.).

***Luffa acutangula* Roxb. (Cucurbitaceae)**

طوری

Tūri (Teh.); Tukhm-i-turi (Afg.); loofah or towel gourd; the seeds.

Field 90.

The plant is called, in Sanskrit, Koshataki, a general name for the genus *Luffa*, from Kosha, the cocoon of a silkworm, and in allusion to the way in which the seeds are enclosed in a thin, fibrous network, which when dry is used as a flesh brush or bath sponge. The seeds are gray, oval, flat, 12 to 14 by 8 mm., with a rough surface marked with small, irregular, black specks. The seeds are medicinal; they possess purgative and emetic properties and yield an oil.

***Mallotus philippinensis* Muell. Arg. (Euphorbiaceae)**

قنبلیله

Qunbalilah (Teh.); Kamela (Hind., Bom.); Kapila (Mad.); kamala.

W.H.M.M. 150845.

Kamala consists of the red glands that form on the fruit of this tree, which grows throughout tropical India. The drug is a red, heavy powder, somewhat gritty, insoluble in water, but partly dissolving, with an orange color, in alcohol. This drug is used as an anthelmintic. Formerly employed as a dye for silk and wool, it has been almost entirely replaced by aniline dyes.

***Malva sylvestris* L. var. *mauritiana* Boiss. (Malvaceae)**

گل پنیرگ

Gul-i-panirak, Tukhm-i-khābāzi (Teh.); Khitmi-i-kuchak, "small khitmi" (Pers.); Penirek, Khib-baze (Schl.); Hamam Komandji (Turk.); flowers and fruits of common mallow.

Boiss. 1: 819; Ph. Ind. 1: 204.

Field 26, 212, 84A; W.H.M.M. 150757, 150796; K.B. 326.

Aitchison says the flowers of the mallow, called Gul-i-khatmi, are collected in northeastern Iran, and exported for medicinal purposes. Khabazi is the Arabic name of the fruits imported into India from Iran. In the samples from Tehran both flowers and fruits of

the above species of mallow occur, although Panirak ("little cheeses") refers only to the rounded fruits. Khatmi or Khitmi is usually applied to the larger plants belonging to a species of *Althaea*. The mallows have mucilaginous and cooling properties, and are given for coughs.—Mixed with violet flowers, *Nymphaea alba* L., jujube, sebestan, and *Alhagi camelorum* Fisch., mallow is sometimes prescribed as a purgative (H.F.).

Matricaria Chamomilla L. (Compositae)

بابونه

Bābūnah, Tukhm-i-bābūnah (Teh.); Babunaj (Pers.); Baibun (Mosul); camomile flowers.

Field 142, 202; W.H.M.M. 150732, 150904.

Formerly the camomile flowers met with in the bazaars were all obtained from northern India and Iran, and were the flowers of the above plant, named after the village of Babunah in Arabia where it was particularly abundant. Other fragrant composites occasionally make their appearance. The camomiles sold in the bazaars of Iraq consist of flowers of *M. aurea* L. (G.). Post identifies those in Syria with *Achillea fragrantissima* Forsk. (see *Anthemis*). We have received from Tehran a drug under the name of "Mukhlisah" (Maglah), which is *Matricaria* (?*decipiens*). Camomiles are carminative, stimulant, and febrifuge.—Camomile tea prepared from the daisies is given to relieve intercostal neuralgia. An infusion of the drug is prescribed for dysentery (H.F.).

Medicago sativa L. (Leguminosae)

قث

Qatt, Jatt (Ar.); Winjah, Yunjah (Kurd.); Aspust (Bal.); Spistha (Afg.); lucern or alfalfa.

Field 29 (Jaffa Lucerna), 62 (Iraq).

Alfalfa is a native of western temperate Asia. It is extensively cultivated in Khotan, and is largely grown in many parts of India. There are at least two varieties; the Kandahar, and the Irani or Arabian. The latter, doubtless of Iraqi origin, is generally free from dodder and for this reason the seed was exported annually before the World War from Basra to South Africa (G.). The seeds are oval or rounded, 2 mm. long, brown, white, or greenish in color.—They are used as a cooling poultice for boils (H.F.).

Melia Azedarach L. (Meliaceae)

سنجد تلخ

Sinjad-i-talkh (Teh., Isf.); Mab-ul-dan (Ar.); Bakayan (Hind.); China tree fruits.

Field 443; W.H.M.M. 150840.

The China tree or Persian lilac was probably introduced into the southern parts of India by the Mohammedans, and various parts of the tree have long been used in medicine by the Arabs and Persians. The fruits are called Sinjad-i-talkh or bitter sinjad to distinguish them from sinjad, the fruit of the oleaster (*Elaeagnus angustifolia* L.). The berries are oblong or rounded, 12 mm. in length, with smooth, wrinkled, reddish brown skin, a pulpy, bitter flesh, and hard, five-grooved stone. The fruits are given for fevers. The stones are worn as a necklace to avert contagious diseases.

Mentha sylvestris L. (Labiatae)

Pūnah (Teh.); Gul-i-punah (Isf.); Pudina (Hind.); leaves of mint.

Field 256, 412; W.H.M.M. 150811.

The wild mint is indigenous to the temperate western Himalayan region and to Iran. The general name for mint, best known in the East, is Fudanaj, the Arabic form of the Persian word, Pudina. The author of the "Makhzan-el-Adwiya" describes three kinds of Fudanaj: the wild, mountain, and water mint. Mountain mint has hoary leaves, but the specimens from Tehran, although fragrant, are too imperfect to name specifically. Different kinds of mint are cultivated in gardens and are used as domestic remedies on account of their pleasant odor and stimulant and carminative properties.

—Mint leaves are prescribed for waterbrash or pyrosis; they are also prepared like tea for chills, rheumatism, and dysentery (H.F.).

Merendera persica Boiss. (Liliaceae)

سورنگان سفزه شده

Sūrinjān-i-sufrah shudah (Teh.); the corms.

Ph. Pers.; Boiss. 5: 167; Schl.; Ait.; Ph. Ind. 3: 496.

W.H.M.M. 150870; K.B. 326.

This plant, allied to *Colchicum*, occurs in North Iran, Afghanistan, the juniper tracts of Baluchistan, and in the Punjab. Aitchison found this plant common all over the Badghis and Khorasan. The corms are collected as a medicine and exported from Meshed through Iran via the Persian Gulf to India. The drug is one of the forms of the ancient Hermodactyl. It is probably the Surinjan-i-shirin or sweet Surinjan, a medicine used by Mohammedans in India. The root from Hamadan is broken into pieces showing a white, starchy fracture with no perceptible taste or smell. The drug is said to have the same action as the bitter Surinjan (*Colchicum* spp.) as a remedy for rheumatism.

Mirabilis Jalapa L. (Nyctaginaceae)

تخم لال عباس

Tukhm-i-lāl'abbās (Teh.); Gul-i-abbasa (Pers.); fruits of the marvel of Peru.

W.H.M.M. 150895.

The marvel of Peru or four-o'clock is a plant of tropical America. It is named *Mirabilis*, or wonderful, on account of the variegated colors of the flowers, and *Jalapa*, as it was formerly supposed to be the true jalap plant. The fruits are oval or vase-shaped, 8 by 5 mm., dark reddish brown, five-ribbed, and papillate, containing a white, starchy seed. Little is known about its medicinal action, but the fruits have been said to be used in adulterating black pepper.

Morus nigra L. (Moraceae)

شاه توت

The fruits: Tūt-i-kushk (Teh.).

The root: Rīshah-shāh-tūt (Teh.).

The tree: Shāh-tūt, "royal mulberry" (Pers.).

Field 46A, 269, 402; K.B. 327.

The black or grafted mulberry is cultivated in Iran and Baluchistan, principally for its fruit; the white mulberry (*M. alba*), for sericulture. They both yield fruit which in season is sold in the bazaars and met with in nearly every household (Ait.). When carefully dried, the fruits are called Tut-i-dham, and supply a wholesome and nutritious article of diet during winter.

The other drug of the mulberry tree from Tehran consists of the bark of the root, reddish colored externally, with strong, silky white liber cells. It is used for dysmenorrhea.

Myristica fragrans Houtt. (Myristicaceae)

جوز بویا

Jauz-i-būyā, "fragrant nut" (Teh., Ar.); Bazbaz (Pers.); Jaephāl (Hind.); nutmeg and mace.

Field 147; W.H.M.M. 150851.

The well-known seeds of the nutmeg are used all over India and Iran as a spice and for medicinal purposes.

Mace, the aril or testa, called Gul-i-jauz or "flower of the nutmeg," is sold and employed for the same purpose as the kernel.

Myrtus communis L. (Myrtaceae)

تخم مورد

Tukhm-i-mūrd (Teh.); Hab-el-aas (Ar.); Uurd (Abu Mansur); myrtle fruits.

مورد سبز

Mūrd-i-sabz; Barg-i-mūrd (Teh.); leaves of the myrtle.

Field 24; W.H.M.M. 150814, 150827.

Myrtle berries are black, pea-shaped, aromatic, and slightly sweet; each fruit contains several white, hard, kidney-shaped seeds. The leaves are small, lanceolate, and dotted with glands, emitting an agreeable odor when bruised. All parts of the myrtle contain a volatile oil to which the virtues of the plant are due. The plant is stimulant and astringent, and the volatile oil is antiseptic, parasiticide, and rubefacient.—It is applied hot as a poultice for boils (H.F.).

Nannorrhops Ritchieana Wendl. (Palmae)

کا کل زرد

Kākil-i-zard (Teh.); Khove, Khū (Afg.); fiber of the dwarf palm. W.H.M.M. 150798.

The soft fiber or tomentum, very like camel's hair, from the petioles of this palm is used as tinder and for dressing wounds. Khū is the name in Afghanistan for tinder obtained from any source and used in lighting pipes and fires.

Nardostachys Jatamansi DC. (Valerianaceae)

سنبل لطیف

Sumbul-i-latīf, Sumbulu'l-tib (Teh., Isf.); Sumbul-jibālī (Ar.); Jata-masī (Sans., Hind.); Balchar (Afg.); Bekh-i-sumbul (Pers.); musk root, Indian spikenard.

Field 3 (Isf.), 423; W.H.M.M. 150745.

The above plant, growing in the alpine Himalayas, yields the Nardus root or spikenard of the ancients. The rhizome is short, thick, and dark gray, crowned by a bundle of strong fibers called by the natives "Devil's hair." The odor resembles valerian, and yields about 1 per cent of volatile oil containing valerianic acid. The physiological action is similar to that of valerian root, and the drug is administered for nervous disorders.—Prepared like tea it is given for heart diseases (H.F.).

Nepeta micrantha Bunge and **N. ispahunica** Boiss. (Labiatae)

زونا

Zūfā, Zūnā (Teh.); Zufah-i-yabis (Ar.); the flowering herb.

Boiss. 4: 166; Achundow; Ph. Ind. 3: 116.

Field 23; W.H.M.M. 150733; K.B. 327.

Zufah is a fragrant plant used since primitive times as a carminative in the East. It has often been referred to as hyssop, but recent examinations have shown it to be *Nepeta*. Dymock found the Zufah of Sind to be *N. ciliaris* Benth., while the plant of that name in Baluchistan is *N. bracteata* Benth. Two specimens from Tehran consist of the fruiting calyx, flowers, and seeds. The calyx is erect, green, with purplish, acute teeth. The seeds are oblong, brown, 1 mm. in length, with a white, V-shaped scar at the end. They are mucilaginous when placed in water and are given for influenza and catarrh.—As an aromatic mint a cold infusion is prescribed for pain in the chest (H.F.).

Nicotiana Tabacum L. and **N. rustica** L. (Solanaceae)

توتون

Tūtūn (Iraq); Tambaku, Tumaku; *N. rustica*=Turkomani tambaku (Afg.); tobacco leaves.

Field 89 (Iraq); 18, 23.

Tobacco is cultivated in northeastern Iran for local consumption as well as for local trade. It is an expensive crop there, as the fields must be heavily manured and require careful irrigation. The leaf is frequently treated with gur or crude sugar to moisten and add weight to the leaf. Beside being smoked, it is extensively used as an errhine or snuff (Nashwar). This is sometimes mixed with powdered ashes of *Ephedra pachyclada* Boiss., Huma (Gnetaceae) to render it more pungent. Two samples of snuff are noticed in the collection:

Thebba (253 Iraq). Snuff, tobacco powder soaked in 'Araq.

Bernooty (234 Iraq). Snuff, tobacco powder perfumed with jasmine.

***Nigella sativa* Sibth. (Ranunculaceae)**

سياه تخمه

Tukhm-i-siyāh, Siyāh-danan, Siyāh-tukhmah (Teh.); Hab-es-souda (Ar., Egy., Iraq); Kala jira, Mugrila (Hind.); false or black cumin, fitches.

Boiss. 1: 68; Ph. Ind. 1: 28.

Field 42; 56A; 7, 21 (Iraq); W.H.M.M. 150906; K.B. 327.

This is an annual herb, sometimes called nutmeg flower or fennel flower, cultivated in Egypt, Syria, and Iran. According to Birdwood, the seeds are the black cumin of the Bible, the melanthion of Dioscorides, and the gith of Pliny. They are black, triangular, 3 mm. long, the testa rough-wrinkled, with a white, oily kernel within. When crushed they have a pleasant odor of lemon. The seeds contain an essential oil, a fixed oil, and a saponin-like body, and are used extensively as a spice and medicine. The ancient Mohammedan custom of sprinkling the seeds, like those of cumin, over the surface of bread, still prevails in Tehran and Tabriz. There is an Arab proverb: "In the black seed is the medicine for every disease except death." Around Tabriz *N. arvensis* L. is cultivated as a potherb and for its seeds. It is called Gara tsochorek oti, "Black bread weed" (Gilliat-Smith).

***Nymphaea alba* L. (Nymphaeaceae)**

گل نیلوفر

Gul-i-nīlūfar, Nīlūfar-i-kirmānashāhī (Teh.); Nenuphar (Ph. Pers.); white water lily flowers.

Ait.; Boiss. 1: 104; Fl. Br. Ind. 1: 114; Ph. Ind. 1: 70.

Field 10, 207; W.H.M.M. 150781, 150858; K.B. 328.

These are the flowers, stalks, and leaves of the white water lily, found in ponds throughout Europe and Siberia. Nīlūfar is a name also applied to flowers of other water lilies, and sometimes to species of *Ipomoea*, which have blue flowers. Kamal, the flowers of a *Nymphaea*, is sold in drug shops in India, and occasionally the flowers of the sacred or Egyptian lotus (*Nelumbium speciosum* L.) are used medicinally throughout China. The flowers have cooling and astringent properties, and are administered locally, especially to

children, for fevers and chest troubles (C.).—For this purpose the flowers are often mixed with *Adiantum Capillus-Veneris* L., jujube, violet flowers, oxtongue, and sugar (H.F.).

Ochrocarpus longifolius Benth. & Hook. (Guttiferae)

نور موش

Nūr-mūs, Normush (Ham.); Tambrā (red) nagkeshur (Pers.); the flower buds.

Fl. Br. Ind. 1: 270; Ph. Ind. 1: 172.

K.B. 328.

This tree, called cobra saffron, grows in the western part of the peninsula of India from Canara to the Concan. The flower buds come principally from Rajapur and the Deccan. The reddish brown, globular buds, like cloves, are astringent, and are used for dyeing silk. In Iran, where they seem recently to have been introduced, they are used as an aromatic tonic.

Ocimum Basilicum L. (Labiatae)

تخم ريحان

Tukhm-i-raihān (Ham., Teh.); Ruhan (Kurd.); Takmeria (Bom.); Semen Basilici (Old Herbals); Alfabaca (Port.); sweet basil.

Ait.; Boiss. 4: 534; Fl. Br. Ind. 4; Ph. Ind. 3: 83.

Field 84A; W.H.M.M. 150830; K.B. 728.

The sweet, Roman, or garden basil is a native of India and Iran, and is distributed in Africa and Malaya. Raihan is the Arabic name for "the herb," and the plant is a potherb much used for its mint-like aroma. The "seeds," long known in medicine, are said to be the Badranj of Avicenna. Large quantities are imported into India from Iran. The nutlets or "seeds" are blackish, oblong, 2 to 2.5 mm. long, broad, punctulate, slightly arched, with a white umbilicus at the narrow end. When placed in water, they immediately become coated with a semi-opaque mucilage. Schlimmer remarks that the seeds are eaten with bread and cheese.—The seeds are prescribed as a cold infusion for influenza (H.F.).

Ocimum canum Sims (Labiatae)

تخم شربتی

Tukhm-i-sharbatī (Ham., Teh.); Tukhm-chirbatī, Reyhane Kouhi, Badroudge ibieze (Schl.); white basil.

Field 194; W.H.M.M. 150774; K.B. 328.

Schlimmer remarks that Shiraz supplies Iran with these seeds and adds that they are an indispensable ingredient in iced sherbet (sorbets à la glace). The seeds, or nutlets, are black, punctulate, oblong or ellipsoid, 2 by 1 mm., arched on one side, with a bifurcate line on the other. They are smaller than those of the sweet basil, with a less prominent, white umbilicus, but, like them, they become coated with opalescent mucilage when placed in water. The seeds are given locally for lung and chest complaints and as a heart tonic.

Olea europea L. (Oleaceae)

زیتون

Zaitūn; olive.

Cultivated for its fruits and for the extraction of oil, the olive tree provides an important article of diet and medicinal remedy.—Leaves are sometimes prepared as a decoction for coughs (H.F.).

Onosma echioides L. (Boraginaceae)

ریشه هوہ چوبہ

Rishah havah-i-chūbah (Ham.); Havah-i-chūbah (Teh.); Ratan-jot (Hind.); Indian alkanet root.

Achundow; Schl.; Boiss. 4: 181; Fl. Br. Ind. 4: 178; I.H.B.; Ph. Ind. 2: 54.

Field 165; W.H.M.M. 150718; K.B. 329.

This plant, growing in Afghanistan and Siberia, affords a root which is substituted for European alkanet (*Anchusa tinctoria*), from Al-kanna of the Arabs, employed as a dye and medicine in early times. The root of the allied species, *O. Hookeri* Clarke, is called Ranj-i-badshah, "King's dye." The tapering root has a purplish red color, and the cortical portion easily separates in flakes. It imparts its color to oils and spirits, and is used in coloring medicinal preparations. In Iran the root is powdered and given to horses for coughs and as a condition powder.

Orchis latifolia L. (Orchidaceae)

سعلب

Sa'lab (Teh.); Salab-misri (Ar.); Punjab-i-salaba; Oriental salep.

Field 229; W.H.M.M. 150908.

Palmate or hand-shaped tubers of orchids are considered the best for medicinal purposes. They are deprived of their epidermis by

scalding in water and then dried. They are hard, horny, whitish, opaque or translucent, branching tubers, mucilaginous when placed in water. A gruel made of these roots is esteemed as a nervine tonic, demulcent, and nutritive.—As an infusion it is given to relieve hoarseness (H.F.).

Oryza sativa L. (Gramineae)

برنج سدري

Birinj-i-sadri, Berij sadri Gilan (Teh.); Timan (Iraq); Ruzz (Ar.); Shilib, Pīrinj (Turk.); Chaltuk (Kurd.); rice grain.

Field 58, 72; 15, 18, 20, 34 (Iraq).

"Rice is cultivated as a summer crop over immense areas, especially in the southern marshes, also in the valleys of Kurdistan and on the flow canals of certain regions in lower Iraq" (G.). There are three main types of the crop represented in the above specimens from Iraq: (1) Harfi or early-sown, (2) Afli or late-sown, and (3) Shittāl or transplanted.

Timan is the hulled rice of Iraq. The two samples from Tehran are of fine, white, table rice.

Panicum miliaceum L. (Gramineae)

ارزن

Arzan (Pers.); Dukhn (Iraq); China (Hind., Sans.); millet grain.

Field 57, 106A; 22, 80 (Iraq).

Common millet is cultivated as a summer crop in Iraq, especially along the Shatt-al-Hai. The grain can be cooked and eaten whole or made into bread. It is commonly used in the form of porridge. The green plant is an excellent fodder for animals.—The seeds provide feed for chickens (H.F.).

Papaver somniferum L. (Papaveraceae)

کوکنار

Kavl-a-kūknār, Pōst-a-kūknār (Pers., Afg.); poppy heads.

تخم خشخاش

Tukhm-i-khash khāsh; Tukhm-i-shaga'ig (Ham.); Kishkash (Ar.); poppy seeds.

Ait.; Post; Ph. Ind. 1: 73.

Field 48, 64, 81A, 82A, 185; W.H.M.M. 150835, 150911; K.B. 329.

Opium is known locally as Afyun, but the cultivation of the opium poppy is prohibited in Iraq. The capsules, some of them scarified, are sold in the bazaars, but their narcotic effects are less powerful and more uncertain than those of opium. The seeds contain 50 per cent of drying oil, which is sometimes called Roghan-ikhāsh khāsh. The seeds, often erroneously supposed to be poisonous because they are contained in the opium-yielding capsule, are wholesome and nutritious, and are eaten chiefly in sweetmeats.—The seeds are given to relieve epistaxis; an oil derived from them is employed in making soap. The fruits mixed with *Malva sylvestris* L. var. *mauritiana* Boiss. and *Linum usitatissimum* L. form a paste for application to boils (H.F.).

Parmelia kamtschdalis Esch. A lichen. See *Roccella Montagnei* Bél.

Peganum Harmala L. (Rutaceae)

تخم اسفند

Tukhm-i-isfand, Sipand (Teh.); Harmal, Harmal rutbah (Ar., Iraq); Aspad (Kurd.); Uzarih (Turk.); the Syrian rue.

Achundow; Schl.; Post; Boiss. 1: 917; Fl. Br. Ind. 1: 486; Ph. Ind. 1: 75; Weisner 44.

Field 46; 4, 26, 27, 119 (Iraq); W.H.M.M. 150850; K.B. 329.

The mountain rue is a plant of Iran, Arabia, Syria, North Africa, and southern Europe. The plant and seeds were used medicinally by the Greeks and Romans, and were noted in European herbals in the 17th century. The seeds are exported from Iran into India, where the plant was originally introduced by Mohammedans. The seeds are dull gray, 2 mm. long, angular, having a bitter taste, and, when crushed, a heavy, narcotic odor. The active principle resides in the alkaloids, harmaline and harmine. The custom prevails in Iran and Iraq of sprinkling the seeds on burning coals at marriages to avert the malignant influence of the Evil Eye; the smoke from the burning seeds is said to drive away epidemics. The seeds are reputed to be an alterative and purifying medicine, and are supposed to stimulate the sexual system.

Peucedanum graveolens Benth. & Hook. (*Anethum graveolens* L.)
(Umbelliferae)

تخم شویذ

Tukhm-i-shivīd (Teh.); Shivit (Isf.); Shabbīt (Ar.); Sawa, Soyah (Hind.); Habbat Halwah (Iraq); Anitum (Yunani); dill.

Field 69, 409; W.H.M.M. 150847; K.B. 303.

The well-known dill is a tall, annual or biennial herb, with a strong, aromatic odor, finely dissected leaves, and umbels of yellow flowers. Dill fruits are sold in the bazaars and used as a condiment and carminative. On distillation they yield an oil used in medicine for the preparation of dill water. The plant is often confused with fennel and the fruit with caraway seed; hence the name *Karawyah*, sometimes used. In Iran dill serves as a potherb; the leaves are cooked with rice as a condiment to restore lost appetite.

***Phaseolus radiatus* L. (Leguminosae)**

ماش

Māsh (Iraq, Pers.); Urd or Urid (Ind.); Masha (Sans.); the seeds.

Field 76A, 274; 5, 60 (Iraq).

Mash is cultivated as a summer pulse crop, sometimes mixed with maize or sorghum. The green pods are eaten as a vegetable, and the plant is used as fodder or green manure. The small, green, oblong beans are cooked and eaten, made into biscuits, cakes, and sweetmeats. In Afghanistan this pulse is so much esteemed that it is called Mash-i-maha, "the king of peas."

***Phaseolus vulgaris* L. (Leguminosae)**

فاصوليه

Fāsūliyah (Iraq); Lubia, Lubia-kermiz (red) (Teh.); Rāzmah (Kash.); French bean; the seeds.

Field 69, 70, 77A, 75 (Iraq).

The French or kidney bean is grown as a vegetable or a pulse in kitchen gardens. The pods can be eaten green and the ripe seeds dried as haricot beans, or white soup beans.

The beans are ovate, oblong, 12 to 14 by 6 to 8 mm., white, red, or brown, splashed with black streaks, the hilum on the inner side.

***Phoenix dactylifera* L. (Palmae)]**

نخل تمر

Tamr (ripe fruit), Rutab (half ripe), Khalal (unripe), Nakhli (male tree), Khurmā; the date palm, date.

[Date gardens are found on both sides of the Euphrates from An Nasiriya to Basra. From Nahr Umr down the Shatt-al-Arab to Fao is the largest date-growing district in the world. There are

date gardens on both banks which vary in width from a few hundred yards to five miles. The date is the most important crop in Iraq (G.).

The best variety of Iraq dates is grown in the Suq district. The finest fruit is produced when the tree is between twelve and forty years old. Over a hundred varieties are known, but in Iraq they may be divided into two classes: (a) those used chiefly for trade; (b) those used for local consumption.

(a)	(b)
1. Halawi	1. Mishi
2. Khadrawi	2. Gentar
3. Sa'ir	3. Hasawi
4. Daiiri	4. Khasib
5. Za'adi	5. Lihur
6. Digal	6. Barhi

Of these 60 per cent are of the Sa'ir variety. The Halawi are popular in America, the Khadrawi sell in Europe while India and Iran are content with the Sa'ir varieties. The numerous uses of the date palm are proverbial.—The fruit yields a syrup and is used in making the local spirit, 'araq (H.F.).

Phyllanthus Emblica L. (Euphorbiaceae)

آملہ سفہ

Amulah-i-suftah (Teh.); Amulah-mugashshar (Isf.); Amlaj (Ar.); Aola amla (Hind.); Kurk amla=dried fruit, Amla morabba=preserved fruit, in Turkestan; emblic myrobalans.

Field 16 (Isf.); W.H.M.M. 150871.

This tree grows throughout tropical India, and is valued for its fruits which, when dried, constitute the emblic myrobalans of commerce. As met with in the shops, the drug occurs in broken sections of a fruit, smaller than a walnut, with dried pulp and hard, woody endocarp. The pulp is very acid and contains much tannin. The fruit is astringent, stomachic, and refrigerant; mixed with grape juice and honey it is a favorite drink for fever and diarrhea.

Physalis Alkekengi L. (Solanaceae)

کاکنج

Kākanj (Isf., Teh.); Gul-i-kākanj; Alkikenji (Ar.); clammy winter cherry.

Achundow; Boiss. 4: 287; Post; Ait.; Schl.; Ph. Pers.; Ph. Ind. 2: 560.

Field 12 (Isf.), 162; W.H.M.M. 150721; K.B. 330.

[This is a plant of Arabia, Syria, Iran, and Baluchistan, distributed also in Europe. The berries are like dried cherries, but full of pulp, in which are embedded many reniform, yellowish seeds. As sold in the bazaars, broken fragments of the red, accrescent calyces are mixed with the drug. The fruits are said by Schlimmer to be hydragogue and vermifuge. Achundow indicates their use in certain female complaints. Locally they are regarded as a remedy for syphilis, and are supposed to be intoxicating when taken in sufficient quantity.]

Pimpinella Anisum L. (Umbelliferae)]

انیسون

Anisūn, Badian-i-rumi (Teh.); Antchibun, a corruption of Anisum (Tab.); Erva dos, from Portuguese Herba doce (Dymock); aniseed.

Ait.; Boiss. 2: 866; Schl.; Ph. Ind. 1: 131.

Field 25; 35A; 10 (Iraq); W.H.M.M. 150768; K.B. 330.

[Aniseed is cultivated largely in the U.S.S.R., as well as in Iran, for its seed, which is employed as a condiment and medicine. The fruit is often confounded with fennel, as the Arabic name Badian in some districts is applied to aniseed and in others to fennel. Aniseed has been introduced into India from Iran, whence the supply for the Bombay market still comes. It is mainly a Mohammedan medicine and is given in cough mixtures, and as a flavoring agent. Arak-badiani or anise water, prepared by distillation, is mentioned by Schlimmer, and local spirit is still flavored with it. The active principle resides in an essential oil consisting of 80 to 90 per cent of solid anethol, which separates slightly below ordinary temperatures, and anisic methyl charvicol.]

Piper Cubeba L. (Piperaceae)]

کاه چینی

Kabābah-i-chīnī (Teh., Isf.); Kabab-chini (Hind.); cubeb pepper.

Field 25, 440; W.H.M.M. 150880.

[Cubeb or tailed pepper is imported from Malaya and Java; it was formerly supposed to have come from China. The commercial drug consists of nearly globular fruits measuring about 4 mm. in diameter, of grayish brown or black, reticulately wrinkled on the surface, and abruptly prolonged at the base into a slender stalk or "tail." Within the pericarp is a single seed. Cubebs exhale, when

crushed, a spicy odor, and possess a strong, spicy, and bitter taste. They have a stimulant and antiseptic action on the mucous membrane of the genito-urinary organs, and are also a diuretic.

***Pistacia integerrima* Stew. (Anacardiaceae)**

چهار تنخوش

Chahār tankhūsh (Teh.); Chatlanguch (Ham.); Kharshnai (Kash.); fruits.

W.H.M.M. 150839; K.B. 331.

[This is the northwestern Himalayan form of the turpentine tree, called also the false or donkey mastich. The small drupes are broader than long, 5 by 6 mm., glabrous, rugose, gray with a bony stone. They have a marked terebinthinate odor, and are used locally to impart flavor to milk.]

جفت

Field 201; W.H.M.M. 150706.

Under the name of Jift or Juft, the broken shells of the galls of the turpentine tree are sold in Tehran. Being very astringent, they are used for tanning; mixed with lime, they remove hair from skins.

***Pistacia Khinjuk* Stocks. (Anacardiaceae)**

حب الغار

Habbu'l ghār (Isf.); Habul-khazra (Teh.); Hebbul-beneh (Ar.); the fruits.

Field 449; 116 (Iraq); K.B. 331.

سبز قلنج

Subz-i-gulanj (Teh.); Buzghanj (Ham., Isf.); Gul-i-pisteh (Bom.); Afs-el-batum (Tri.); the galls.

Ait.; Boiss. 2: 6; I.H.B.; Ph. Ind. 1: 377.

Field 422; W.H.M.M. 150878; K.B. 331.

This tree is common in Iran, Baluchistan, and Afghanistan, and has been described under different species names. The tree yields a resin-like material, and the nuts, which are eaten, afford a sweet oil; the leaves and galls are employed for tanning. The small, seed-like fruits are oval in shape, 6 mm. long, reddish brown in color, with an acid taste and terebinthinate odor. The fruits are eaten and are said to be good for debility.—Prepared like tea, they relieve stomach pains (H.F.).

The galls are formed by *Pemphigus utricularius* Pass. (figured in "Les Zoécécidies des Plantes d'Afrique, d'Asie et d'Océanie," by C. Houard, 1923, figs. 1010-1012, p. 471, under *P. atlantica* No. 1731). They contain about 40 per cent of gallotannic acid, are ovoid, larger than peas, somewhat fig-shaped, pink in color, turning gray; the wall is thin, brittle, and rugose on the outside, smooth within and translucent. The taste is astringent and slightly terebinthinate. In Persian and Arabic works on medicine the galls are described as cold, dry, and astringent.—Mixed with Indian spikenard they are administered to relieve stomach pains (H.F.).

***Pistacia Terebinthus* L. (Anacardiaceae)**

سقر سفید

Sagiz-i-safid (Teh.); Sages (Stapf); Zunghari, Sukhur; the oleo-resin and leaves.

Field 129; W.H.M.M. 150894.

The turpentine tree grows freely near Banni in the hills of Sherag. Its oleo-resin is a thick, tenacious, white, opaque mass, gradually taking the shape of the bottle in which it is placed; it softens on warming and has a pleasant terebinthinate odor. It is used in Tehran as a chewing gum, and is similar to the Chian turpentine which was recommended about fifty years ago as a remedy for cancer. The leaves are astringent and are used for dyeing.

***Pistacia vera* L. (Anacardiaceae)**

پسته

Pistah (Teh.); pistachio nuts in shells.

Field 265; 49A, 50A, 51A; 124 (Iraq).

پوست پسته

Pust-i-pistah (Teh.); husks of the fruits.

Field 186.

The fruit of the pistachio nut is the size of an olive; its husk is reddish and astringent, its odor terebinthinate. Within the fruit is a woody shell or nut, brownish white in color, with hard, horny, and polished texture and ovoid shape. The kernel or almond is pale green, and covered with a thin, brittle, brown skin, easily removed by scratching. The taste is sweet, oily, and balsamic. The outer husk of the fruit (Pust-i-pistah) is used as an infusion for dysentery and is imported into Bombay from Iran as a dyeing and tanning agent.

The fruits of various species of *Pistacia* have been used as food. Laufer in "Sino-Iranica" remarks that these indigenous trees from ancient times have occupied a prominent place in the life of the Persians. The youth of Persia were taught to subsist on terebinths, and "terebinth eaters" became a nickname. The seeds of the pistachio tree are probably the terebinths referred to, but other species and varieties also afford edible fruits. In Baluchistan the fruits of the Khinjuk tree, called "Shahna," are dried and made into flour and eaten by the poor.

Plantago major L. (Plantaginaceae)

بارھنگ

Bārhang (Teh.); Tukhm-i-bārhang (Ham.); Bizr dinbil (Iraq); Bar-i-tang (Bal.); seeds of greater plantain.

Achundow; Ait.; Schl.; Boiss. 4: 878; Post 668; Ph. Ind. 3: 128; I.H.B.; Gilliat-Smith.

Field 6; W.H.M.M. 150913; K.B. 331.

Greater plantain is widely distributed in temperate countries, and the seeds of this and other species are largely employed in medicine in the East. In Tabriz this plant is called in Turki Bizousha dishi, the female kind; *P. lanceolata* L. is distinguished as Bizousha erkek, the male kind. The seeds are small, oval, 1 mm. long, smooth, and brown. They throw off a transparent, mucilaginous coating when placed in water, on account of which the seeds have a reputation in treatment for affections of the bowels and as a remedy for dysentery. The colloquial name for the seeds in Iraq means "for making poultices for boils." The seeds of *P. Loefflingii* L. are called in Tabriz Karni Yariikh, meaning "healing of the stomach" (Gilliat-Smith).

Plantago ovata Forsk. (Plantaginaceae)

اسفرزدہ

Isparzah (Teh.); Asbaghul, Ispaghul (Pers.); Lisan ul Lamal (Ar.); Psylli semina (Ph. Pers.); Khar-danick (Bal.); spogul seeds.

Achundow; Schl.; Boiss. 4: 855; I.H.B.; Ph. Ind. 3: 126; B.P. 1914.

Field 7; W.H.M.M. 150707; K.B. 332.

This species of plantain is a native of Iran, Baluchistan, and northern India. Stocks observed that it was grown especially in Sind for its mucilaginous seeds, which from the time of Dioscorides

have been a well-known medicine in the East. Large quantities are imported into Bombay from Iran. The seeds are light in color, boat-shaped, pointed at both ends, 2 mm. in length, translucent, with a pinkish tinge, and a brown streak on the convex side; the concavity is covered with a thin, white membrane. They become coated with mucilage when placed in water. In Baluchistan the seeds of *P. ciliata* Desf. are called Isbaghol and are used as a cure for dysentery (Hughes-Buller).

—As an infusion the seeds are given for gonorrhea and any disease in which a cooling effect is desired; they are also used as a diuretic (H.F.).

Plumbago rosea L. (Plumbaginaceae)

شیطراج

Shītaraj, Rīshah tamesh (Teh.); Chitrak (Hind.); Chitra (Bom.); Chitraka (Sans.); leadwort root.

W.H.M.M. 150805; K.B. 332.

[There are two kinds of plumbago roots known in the East, Indian and Syrian. The root from Tehran is dark reddish brown, 3 mm. in diameter, longitudinally striated, slightly twisted, the wood in wedge-shaped bundles. The taste is acrid and biting. The juice of this plant is used by beggars to raise ulcers on their bodies so as to excite pity. Like other species of the genus, it is an active blistering agent. In India it is considered a powerful sudorific.]

POISONS

The following are regarded in Iran as poisonous drugs:

<i>Aristolochia longa</i>	Root	Tehran
<i>Croton Tiglium</i>	Seeds	Hamadan
<i>Datura Stramonium</i>	Seeds	Hamadan
<i>Datura Stramonium</i>	Leaves	Tehran
<i>Datura Stramonium</i>	Leaves	Hamadan
<i>Doronicum Pardalianches</i>	Root	Hamadan
<i>Gypsophila paniculata</i>	Root	Hamadan
<i>Hyoscyamus reticulatus</i>	Seeds	Hamadan
<i>Ipomoea hederacea</i>	Seeds	Hamadan
<i>Iris spuria</i>	Rhizome	Hamadan
<i>Onosma echinoides</i>	Root	Hamadan
<i>Ricinus communis</i>	Seeds	Hamadan
<i>Strychnos Nux-vomica</i>	Seeds	Tehran
<i>Veratrum album</i> L.	Rhizome	Hamadan
<i>Withania somnifera</i>	Root	Hamadan

Polygonum Bistorta L. (Polygonaceae)

ریشه انجبار

Rishah-i-anjabār (Teh.); Anjabar-i-rumi (Pers.); Bikh-anjubaz (Punj.); bistort root.

Ait.; Post; Schl.; Boiss. 4: 1027; Ph. Ind. 3: 150.

Field 192; W.H.M.M. 150832; K.B. 333.

The rhizome sent under this name is nearly cylindrical, about 12 mm. thick, contorted, with thin rootlets below and scars above, reddish brown and wrinkled on the outside, with a ring of vascular bundles between the center and circumference. The root contains tannin and elongated grains of starch. Schlimmer states that bistort root comes to Iran from the U.S.S.R., via Astrakhan; the sample from Tehran came from Kermanshah. Dymock informs us that *P. vivipara* is a substitute for bistort in the Punjab. The root, being very astringent, is prescribed in cases of diarrhea and dysentery. In Kashmir the roots of *P. amplexicaule* Don, called Mānsaril, are employed as a dye.

Polypodium vulgare L. (Polypodiaceae)

سفایج

Bas-fāyij, "many footed" (Teh.); Basfaij (Ind. bazaars); polypody root.

Field 175; W.H.M.M. 150897.

The rhizome of the common polypody is dark brown and wiry, the surface is rugose and longitudinally fissured, presenting several horn-like tubercles or scaly projections, the remains of the stipes of the fronds. It is oval in outline, with an interior of dark or brownish red and resinous. The aroma is disagreeable and the taste acrid. This is a well-known drug described by Achundow and Schlimmer. The root is aperient, alterative, and deobstruent, locally used for intestinal indigestion and rheumatic pains, and as a purgative for bilious disorders.—It is also given mixed with *Zataria multiflora* Boiss. (H.F.).

Polyporus officinalis Fries (Fungi)

غاریقون

Ghārigūn (Teh.); Gharekum (Hind., Bom.); Gharikun (Ind. bazaars); white agaric.

Field 176.

This agaric occurs on the oak and larch, and in sizes as large as a fist or a child's head; it is light, spongy, and friable, and is not easily powdered. The use of this fungus in medicine is of very ancient date. Avicenna insists upon the great efficacy of agaric as an alexipharmic. Mohammedan physicians closely follow the Greeks in considering that it removes all kinds of visceral obstructions and expels diseased humors. It is also a Chinese drug. The light, white, spongy interior is made into touchwood, spunk, or tinder, and was formerly used to absorb blood and secretions from wounds, etc.; hence the old name Fungus or Boletus Chirurgorum given to the plant.

Prosopis Stephaniana Kunth (Leguminosae)

خرنوبان

Kharnūbān, Kornub (Isf.); Shok (Ar.); Kunbut (Syr.); Chughak: "humpbacked, bent," applied to the contorted pods, Tukhm-i-jinjāk (Ait.); the pods.

Field 403.

This is a loose, straggling, thorny shrub of the Caucasus, Syria, Iran, and northern India. The pods are brown or copper-colored, 4 by 1.5 cm., galled, swollen, and contorted, containing several oval, brown seeds separated by soft, spongy dissepiments. The pods are eaten by sheep, but the seeds pass through undamaged and germinate readily at the coming of the winter rains (G.). The pods and roots of the plant are regarded as astringent and are given for dysentery.

Prunus Amygdalus Stokes var. amara Baill. (Rosaceae)

بادام تلخ

Bādām-i-talkh (Teh.); bitter almonds.

Field 52A, 171.

The bitter almond tree, like the sweet, is a native probably of Iran and Asia Minor, and is indistinguishable in botanical characters. In form and appearance bitter almonds closely resemble Valencia almonds, but are usually smaller. They are employed in confectionery and for flavoring, but as the hydrocyanic acid yielded by them varies in quantity, they should be used with caution.—An ointment made of bitter almonds is applied to furuncles (H.F.).

Prunus Armeniaca L. (Rosaceae)

زرد آلو

The fruit: Zard ālū (Pers.); Mishmish (Iraq); Khūbani, with stones removed (Hind.); dried apricot.

The seeds: Hasta-i-zard ālū.

Field 30, 39 (Iraq); 108A.

The home of this tree is in the Caucasus region. Dried apricots are called Pating in Afghanistan, and Chuli by the Botes. Sheets of compressed apricot pulp are sometimes sold in the market as Qamrad-din. In this form the dried apricot preserves its flavor for an indefinite period; it can be used as required after soaking in water, when it swells into a nutritive paste like jam. This substance was one of the rations issued to Turkish soldiers during the War (G.). Apricot kernels, called Stigu in Afghanistan, are used as almonds.

Prunus Cerasus L. (Rosaceae)

هسته آلبالو

Hastah-i-ālbālū (Teh.); Karaz (Ar.); Kerasza (Hind.); cherry stones.

دم آلبالو

Dam-i-ālbālū (Teh.); cherry stalks or peduncles.

Field 144; W.H.M.M. 150810, 150860.

The sour or bitter cherry is a tree of western Asia and eastern Europe. The fruits are light brown, resembling those of the common cherry. The seeds contain kernels having the odor of bitter almonds, are nutritive and tonic and are used in confections. The cherry tree and other plum trees in Iran yield a useful gum called Sumgh alucha.—Cherry stones mixed with barley awns, and cherry stems, are given as an infusion for gonorrhea (H.F.).

Prunus domestica L. var. Juliana (Rosaceae)

آلوچه

Alūchah (Teh.); Anjar (Iraq); Halu zhgarh (Kurd.); Alucha (Hind.); prunes.

Field 268, 95A, 104A.

The dried plums are black, wrinkled, ovate, 20 mm. long, with a sweet, pleasantly acid pulp; the seed is 14 by 12 mm., the kernel has an odor of bitter almonds. On account of their acidity they are preferred for cooking, and are used for cleaning metal.

Prunus institia L. var. bokharensis (Rosaceae)

آلو

Alū, Alū-bokhara (Teh.); Bokhara plum.

Field 271.

[The fruit is globular, sweetish, and acidulous, surface compressed and wrinkled, color reddish or brown, with an odor like that of dates. Inside, the fruit is an almond-like nut in a hard shell, containing a kernel resembling sweet almonds. These plums may be used in place of prunes in the preparation of confection of senna.]

Prunus Mahaleb L. (Rosaceae)]

حب المقلب

Habbu'l-ma'lab (Teh.); Hab-ul-mahaliba (Ar.); Paiwand-e-maryam (Pers.); perfumed cherry tree fruits.

Field 103 (Iraq); W.H.M.M. 150862.

[This small tree occurs in Central Asia and Europe. The drug is found in the bazaars in two forms, the dried fruits and the kernels. The fruits are drupes, brown and oval, 9 by 6 mm., with a wrinkled skin, covering a fragile shell and the kernel. The kernels are light brown in color, ovate, 6 by 4 mm., with the taste of bitter almonds. They are used by Arabian physicians as a stomachic and for general debility.]

Pterocarpus santalinus L. (Leguminosae)]

صندل سرخ

Sandal-i-surkh, Rātiyanah (Teh.); Lal-chandan (Hind.); Ratan-jali (Guz.); red sanders, red sandalwood.

Field 193, 232.

[This wood is the Rakta chandana of Sanskrit writers. It comes from southern India, where the felling of the trees is under government control, and yields a considerable revenue. Hindus and Moham-medans use this wood combined with white sandalwood in bathing and religious services. The use of the red wood in powder for treating bloody fluxes must be based on the "Doctrine of Signatures." The drug called Rātiyanah in Tehran, a remedy for dysentery, appears to consist of chips of this wood. Red sandalwood is well known in Europe as an ingredient in French polish.]

Punica Granatum L. (Lythraceae)]

کَلَنار فارسی

Gulnār-i-farsī, Gul-i-anār (Teh.); Nar (Turk.); Gul nare-farci (Schl.); Flores Punicae granati (Ph. Pers.); pomegranate flowers.

Achundow; Ait.; Post; I.H.B.; Fl. Br. Ind. 2: 581; Ph. Ind. 2: 45; Boiss. 2: 736.

Field 77, 157; W.H.M.M. 150738; K.B. 333.

ریشه انار

Root bark: Rīshah-i-anār (Teh.); Granati Cortex (Ph. Pers.).

Field 184.

Seeds: Chab roman (Bagh.).

Field 98A.

The pomegranate is a small tree with showy, reddish flowers, growing in subtropical countries. The flowers, rind of fruit, and dried bark of the stem and root are medicinal. The flowers are astringent and stomachic; the rind of the fruit is also astringent and is used for dyeing and prescribed for dysentery; the root bark is vermifuge and used for expelling tapeworm; the alkaloid pelletierine is its active principle.—The flowers, powdered with *Nummulites* sp. and *Rhus coriaria* L., are applied to painful gums.

Imm-harmal is a variety with small, black fruits which are used medicinally only (H.F.).

Pyrethrum sp. (?) (Compositae)

Katek bah (?) (Teh.).

K.B. 333.

This drug consists of a tapering root with a few undeveloped leaves arising from the crown. The root has the characters of a composite and the leaves resemble those of a *Pyrethrum*.—The sample is marked "Poison, used as an eye medicine" (H.F.).

Pyrus Cydonia L. (Rosaceae)

تخم بهدانه

Tukhm-i-bihdānah (Teh.); Bibi (Bal.); quince seeds.

Field 5; 53A.

The quince is a native of Central Asia, and is grown for its fruit in most temperate countries. Seeds used in and exported from Iran are irregularly ovoid, angular, adherent to one another by mucilage, and covered with a membrane; the color of the testa is dark brown, and that of the kernel yellowish white; they have the odor and taste of bitter almonds. When roasted and salted they are called Hab-safarjal. The seeds contain a large quantity of mucilage, which favorably recommends them as nutritive, demulcent, and emollient for coughing and dysentery; they are taken in the form of an infusion.

Quercus infectoria Olivier (Fagaceae)

مازو

Māzū (Isf.); Affaz (Teh.); Ajees-aafs (Ar.); Maiphala (Hind.); galls, mad, or Dead Sea apples.

Field 45A, 447; W.H.M.M. 150783.

These galls are excrescences on the twigs of oak trees, resulting from the deposition of eggs of *Cynips gallae-tinctoriae* Olivier. Oak galls are collected in Asiatic Turkey, as well as in the province of Aleppo, and are known commercially as "Aleppo," "Smyrna," or "Turkey" galls. They are nearly spherical in shape, and vary from 12 to 20 mm. in diameter, bluish green externally and yellowish within. They are hard and heavy, and bear short, bluntly pointed projections. The galls contain from 50 to 70 per cent of gallotannic acid, and consequently are used medicinally as a local astringent, to be dusted on wounds. They find an extensive application technically in dyeing and tanning.—In Kurdistan they are sometimes strung as beads and hung over the cradle to ward off the Evil Eye (H.F.).

Quercus lusitanica Lam. var. **tauricola** (Fagaceae)

Talkak (?) (Iraq); Basra galls.

Field 102, 120 (Iraq).

These galls are formed by *Cynips insana* Mayr. on the above oak, and also on *Quercus infectoria*. They are much larger than Aleppo galls, dark brown, oval or subspherical, 4 by 3.5 cm., yellowish brown within, a channel leading to the cavity in the center. They are very astringent and rich in tannic acid.

Quercus persica Jaub. & Spach (Fagaceae)

بلوط

Balūt (Teh.); Glans Quercus Ballotae (Ph. Pers.); acorns.

Field 191; W.H.M.M. 150834.

This is one of the most common species of oak throughout the forests of Kurdistan and the Rowandiz area. The acorns are oblong, 3.5 by 1.7 cm., light brown in color, glabrous, shining, and contain a single seed. Acorns have a styptic action because of the tannin they contain; they are used for colic pains in children, and as a gargle.—In Kurdistan acorns are sometimes eaten raw, but they are usually roasted and the flour made into cakes (H.F.).

Quercus sp. (Fagaceae)

Giash mashi (Ham.); Kisa, Kesa; spiny galls.

Pharmacog.; Connold's British Oak Galls; Houard 375; Ait.; Ph. Ind. 3: 360.

K.B. 334.

These galls are produced by the insect *Andricus lucidus* Hartig. var. *orientalis* Trotter (illustrated in Connold's "British Oak Galls"). This cynipid makes galls on various species of oak. The bazaar specimens are probably brought from Asia Minor; they have long spines which are usually broken off in the commercial samples. They are used by tanners and are sold also as an astringent medicine. This drug is given locally as a febrifuge (C.).

Quercus Vallonea Kotschy (Fagaceae)

کوزی علفی

Gueze elefi, Pune (Teh.); oak manna.

K.B. 334.

Under these names is supplied a confection or cake of sugary substance, green with the presence of broken leaves. It is a form of Tar-anjubin, "green honey," or Gaz-anjabin, "tamarisk honey." Layard referred to this substance in his "Early Adventures in Persia," I, p. 349: "The mountainous country beyond Fellaut is thickly wooded with the 'beloot' or oak. These trees are chiefly valuable for the white substance called by the Bakhtyaris 'gaz' or 'gazu,' a kind of manna. It is an article of export to all parts of Persia, and is sold everywhere in the bazaars, and employed in the manufacture of a sweetmeat called 'Gazenjubeen,' which is much relished and considered very wholesome. When boiled with the leaves and allowed to harden it forms a kind of greenish cake, not disagreeable to the taste, but, prepared for the use of the ladies of the enderun and to be offered to guests, it is carefully skimmed and separated, when it becomes a white paste of very delicate flavor."

Oak manna, manna quercina, Gueza-elefi of Schlimmer, has also been obtained from the leaves and fruits of *Q. mannifera* Lindl. of Kurdistan, *Q. persica* Jaub. & Spach, and *Q. tauricola* Klotzsch. Saccharose, glucose, fructose, and mucilage have been separated from these secretions, but no mannite.

Quisqualis indica L. (Combretaceae)

Rangan-ki-bel (Hind.); Liane vermifuge (Fr.); fruits of the Rangoon creeper.

Field 82 (Iraq).

The Rangoon creeper is cultivated as an ornamental flowering shrub in most parts of India. The fruits are oval or oblong, pointed at either end, and sharply pentagonal. The pericarp is thin, woody, fragile, of a mahogany color, enclosing an oily seed. The medicinal use of the creeper originated in Mauritius and the Moluccas. The seeds are valued as an anthelmintic; four or five seeds bruised and mixed with honey are administered as a dose for expelling lumbrici.

Raphanus sativus L. (Cruciferae)

طربچه

Tukhm-i-turubchah (Teh.); Turb (Pers.); Bazr-el-fujl (Ar.); Tur (Kurd.); Mula, Muro (Hind.); radish seeds.

Field 37; W.H.M.M. 150921.

The well-known radish is cultivated as a vegetable throughout the country. Its seeds, sold in the bazaars, are oblong, 3 to 4 by 2 mm., light reddish brown, with the testa minutely reticulated. They have the pungent taste of mustard. The seeds are diuretic, laxative, and lithontriptic.

Rheum palmatum L. (Polygonaceae)

ریوند چینی

Rivand-i-chinī (Isf., Teh.); rhubarb root.

Field 7 (Isf.); 1, 206.

The appearance of sticks of Chinese rhubarb in the bazaars of Iran indicates the favor in which this medicine is held. It is aperient, stomachic, tonic, and slightly astringent, and promotes the action of the liver without any catharsis.—In Tehran it is used as a paste for syphilitic ulcers (H.F.).

Rheum Ribes L. (Polygonaceae)

کل لیواس

Gul-i-livās, Tukhm-i-livās (Ham., Teh.); Livās, the Persian and Arabic name of the plant; Riwas (Punj.); rhubarb fruits.

Barg-i-livās (Isf.); rhubarb leaves.

Boiss. 4: 1003; Ph. Ind. 3: 153.

Field 22, 400; W.H.M.M. 150885; K.B. 335.

The edible rhubarb is indigenous throughout the moister localities at 3,000 feet and upward. It occurs in great expanses on a northern exposure on the higher hills of Khurasan, marking the country characteristically in the autumn with the brilliancy of its almost

scarlet foliage. The fruit and root-stock of wild rhubarb are collected and employed in medicine; the fruits were official in the "Pharmacopoeia Persica." A decoction of the reddish, triangular-winged fruits is considered a more powerful purgative than that of the rootstock (Aitchison). The fruits are used in Tehran as a vermifuge for horses, and in Hamadan the drug is applied as a poultice for headache. The rhubarb leaves from Isfahan are made into an infusion and used for gonorrhea (C.).

Rhodymenia sp. (Florideae, Rhodymeniaceae)

لیقا

Lyka, Leeka (Iraq); Chinai-ghasa or seaweed.

Field 31A.

This alga, obtained in northern Iran, is light brown and gelatinous. A decoction is given for coughs. As a substitute for agar-agar, it is emulcent, emollient, and alterative, and may be used as a cultivating medium for bacteria.

Rhus coriaria L. (Anacardiaceae)

ساق

Summāq, Summāq-i-shakki bī hastah (Teh.); Tirsh (Kurd.); Tartak (Hind.); leaves, bark, and fruits.

Achundow; Schl.; Boiss. 2: 4; Post; Ait.; Ph. Ind. 1: 373.

Field 164, 272; 107 (Iraq); W.H.M.M. 150800; K.B. 335.

The sumac is a tree cultivated in Khurasan, western Afghanistan, and throughout Central Asia. The leaves have long been used by the Arabs, Turks, Iranis, and in Europe, for dyeing silk and tanning leather. They contain from 15 to 35 per cent of tannin.

The fruit is exported from Iran and used by Mohammedans in India. It is a small, sticky drupe, the size of a lentil, 5 mm. in diameter, red or green, acid, and astringent to the taste, containing one lenticular, polished, brown seed.

—Mixed with *Punica Granatum* L., sumac is applied to relieve painful gums. The seeds in an infusion are used to acidulate foods (H.F.).

Ricinus communis L. (Euphorbiaceae)

گرچک فرنگی

Garchak farangī (Teh.); Karchak (Ham.); Tochme Kertchec (Schl.); Kurwa (Ar., Iraq); Bedanjir, "willow fig"; castor oil seeds.

Field 264; 4, 12, 36, 53 (Iraq); W.H.M.M. 150739; K.B. 335.

The castor oil plant is a native of India, but is common now throughout tropical and subtropical countries. In Iraq and Iran it is cultivated as a windbreak for cotton and other summer crops and in gardens as an ornamental plant. It may attain a height of 10 meters and be a perennial tree, but in cooler climates it is either a shrub or an annual herb. With variations of the plant there are also varieties, large and small, of the seeds. The four samples from Iraq were classed as follows: "Abhangi seeds" 15 by 9 mm., "ordinary" 13 by 10 mm., "Indian red-stemmed" 11 by 8 mm., "Syrian Baladi" 13 by 11 mm. The most important constituent of castor seed is the fixed oil, which exists to the extent of about 50 per cent. The oil is used as a lubricant, as an illuminant, and in medicine as a safe purgative. The oil cake contains all the poisonous property originally present in the seed, hence can not be used as a cattle food; it is, however, an excellent manure and fuel.

Roccella Montagnei Bél. (Ascolichenes, Roccellaceae)

دواله

Davālah (Ham.); a lichen.

Field 28A; W.H.M.M. 150824; K.B. 336.

Achundow refers this drug to *Muscus arboreus*, and gives the Persian names as Dawalak and Karbasu and the Arabic name as Aschna (*Usnea* sp.). The Persian name Davālah is applied to more than one kind of lichen, since Dymock gives *Parmelia kamtschadalis* Esch. as the source of this drug in the Indian bazaars (Ph. Ind. 3: 627). In the Field collection from Baghdad, No. 28A, this drug occurs under the name of "Lihayat as-shāyib." Some of the *Parmelias* are used as a dye. They are gray lichens, in broken pieces, having emollient and astringent properties, used in a bath or as a poultice.

Rosa damascena Mill. (Rosaceae)

گل سرخ

Gul-i-surkh, "red flower" (Teh.); Ward (Ar.); flowers of red rose. Field 42A; W.H.M.M. 150763.

The rose of Damascus is largely cultivated in western Asia. In Turkey, Bulgaria, and the south of France this species yields attar of rose and is the flower from which the official rose water is prepared.

The petals are slightly astringent, and are used chiefly as an agreeable astringent or as a coloring agent. "Gulanjabin," of rose

petals mixed with honey, is a confection sold in Eastern bazaars. "Gulkhand" is a conserve made from equal parts of rose petals and white sugar beaten together.—Rose petals are added to curry as a flavoring (H.F.).

Rosa foetida Herm. (Rosaceae)

کل زرد

Gul-i-zard, "yellow flower" (Teh.); Gole zarde (Schl.).

A. Olivier ("Voyage dans l'Empire Ottoman, l'Egypte et la Perse," Paris, 1807); Boiss. 2: 671.

Field 154; W.H.M.M. 150823; K.B. 336.

The Persian yellow rose is a shrub cultivated in gardens. This is the yellow Austrian briar in a wild state, ranging from the Crimea and Asia Minor through Iran to Turkestan, Afghanistan, and the Punjab to eastern Tibet. Aitchison calls it Gul-i-raman-zeba, "lovely flower" of the Hari Rud Valley. Dried rose petals, obtained chiefly from Iran, are sold in the bazaars in India and are prescribed for colic and diarrhea.

Rosa hemisphaerica Herm. (Rosaceae)

دماوره

Damaverah (Ham.); Dalik, Ward (Ar.); the hips.

Ph. Ind. 1: 574; Boiss. 2: 672; Post.

K.B. 336.

This rose occurs in Iran and Afghanistan, and, according to Post, is cultivated extensively in Syria.

The drug consists of the hips of the plant. They are nearly globular, broader than long, from 10 by 7 mm. to 13 by 8 mm., crowned with the remains of sepals, red, wrinkled, and covered with short protuberances. Within are several light brown, hard, smooth seeds, 4 mm. long, mixed with silky hairs. The fruits are hot, dry, and astringent, and are given locally for stomach complaints.

Rubia Cordifolia L. and **R. tinctorium** L. (Rubiaceae)

روناس

Rūnās, Rūniyās (Teh., Isf.); Rounace (Schl.); Fuwwah (Ar.); Manjit (Hind.); madder root.

Ait.; Boiss. 3: 17; Post 224; Schl.; Ph. Ind.

Field 6 (Isf.); 39; 109 (Iraq); W.H.M.M. 150726; K.B. 336.

The madder plant is grown in hilly districts from Iran to Spain. Aitchison says it is cultivated throughout eastern Iran and it takes three years for the root to attain its proper size. It is grown extensively in Anar-dara, Koin, and Yezd, whence the root is exported in quantity to Herat. From Herat it is re-exported to Afghanistan, Turkestan, and India. The root is used as a dyestuff and medicine throughout the East. It is sold in two forms: one with the cylindrical, red roots in lengths of 1 or 2 inches; and the other with the crushed root made into balls ready for the dyer.

Rumex conglomeratus L. and R. obtusifolius L. (Polygonaceae)

تخم حماز

Tukhm-i-hummāz (Teh., Ham.); the fruits.

Boiss. 4: 1010; Ait.; Post; Ph. Ind. 3: 158.

Field 2, 37, 159; 123 (Iraq); W.H.M.M. 150842; K.B. 337.

The first of these widely distributed species of dock yields a medicinal root known to the ancients as *Radix Lapathi*, but in Iran and India this and other species afford medicinal fruits. Those from Tehran belong to *R. obtusifolius*; they have three wings, are net-veined, irregularly toothed, and red and green in color.—These are given as an infusion for dysentery (H.F.).

The fruits from Hamadan are from *R. conglomeratus* and have shorter wings, not distinctly toothed. They are given in pyorrhea. According to Dymock, Gul-i-hamaz, or “dock flowers,” in India are afforded by the fruits of *R. vesicarius* L., a plant found all over Asia.

Ruta graveolens L. (Rutaceae)

سداب

Sudāb (Teh.); Sudaba (Ar.); Satari (Hind.); Peganon of Scripture; garden rue, herb of grace.

Field 170; 84 (Iraq); W.H.M.M. 150784.

This perennial herb is cultivated in southern Europe and the East. It is about 1 m. high, with glaucous foliage, yellow flowers, and small tricoccus capsules and black seeds. The odor is peculiar and mint-like, and the taste acrid and bitter. In the market the drug occurs as a mixture of broken leaves, stems, stalks, and fruits. Rue in small doses is a tonic, digestive, and aphrodisiac. In a fresh state it is an active irritant. Rue yields a volatile oil and a bitter, yellow glucoside, rutin.—Mixed with mast, it is applied to relieve itching (H.F.).

Saccharum officinarum L. (Gramineae)

شکر سرخ

Shakar-i-surkh (Teh.); sugar cane.

W.H.M.M. 150711.

This is a sample of crude sugar or Gur, a soft, saccharine mass, reddish in color, and very soluble in water. The unrefined, dark brown Guda of the Hindus was known to the ancient Persians, as well as Shakar from which the dry, crystalline sugar was made. At Leh there are five kinds of sugar imported: Tavi misri, flat cakes; Kusa misri, heavier cakes; Khand, soft brown crystals; Gur, coarse sugar; and Shahi or Kashi, sugar candy. The vernacular names Misri (Egyptian) for refined sugar, and Chini (Chin.) for sugar candy, indicate the comparatively recent introduction of these products into India and Iran.

Salix fragilis L. (Salicaceae)

بید خشت

Bid-khisht (Teh.); Bid-anjabin, "willow honey" (Afg.); Bide Knecht (Achundow); willow manna.

Field 127; W.H.M.M. 150748.

A saccharine secretion afforded by a species of willow has been referred to by old writers on Eastern medicine. The drug occurs in small, dirty white lumps, resembling in taste the European manna obtained from the ash (*Fraxinus Ornus* L.) of Sicily. It is recommended for *Herpes labialis*, or thrush.

Salvia Hydrangea DC. (Labiatae)

Gul-i-arbore(?) (Teh.); Issikuttuz (Turk.); Sarsand (Bal.); the flowers.

Boiss. 4: 606; Ph. Ind. 3: 94; Kew Bull. 1930, 459.

K.B. 337.

This is a handsome flowering plant of Iran, Baluchistan, and Afghanistan. The drug consists of the mauve flowers with green-veined bracts and small, rounded, brown seeds. Dymock says it is allied to Jadeh, probably a *Teucrium*. The flowering tops of a *Moluccella*, having enlarged purple calyces and a balm-like odor, and the rose-colored, mucilaginous calyces of *Hymenocrater elegans* Br., are used in medicine in Iran under the name of Gul-i-serwaj. In Tabriz the inflorescence of *S. Hydrangea* is used for making a

medicinal tea.—In Tehran the drug is said to stop excessive menstruation (H.F.)

Salvia macrosiphon Boiss. (Labiatae)

تخم مرو

Tukhm-i-marv, Tukhm-i-anjarah—Anjarah is a Persian name for the mucilaginous seeds of *Blepharis* (Teh.); Kanocha, Marv (Isf.); seeds.

Field 136, 197; W.H.M.M. 150853; K.B. 338.

Schlimmer, Aitchison, and Dymock refer to species of sage used in medicine under the name of Kanocha. Stapf has shown that they are identical with those called Marv, and belong to the above species of *Salvia*, a plant of Afghanistan and Iran. The seeds are light brown or greenish, oval, lens-shaped, 3 mm. in length, the polished surface having wavy or branching markings. The seeds are mucilaginous when placed in water; they are used for debility.—They are also given to alleviate heart disturbances in pregnancy and phlegmasia after childbirth (H.F.).

The seeds of *S. aegyptica* L., called Maur in Baluchistan, are said to be a remedy for eye diseases.

Salvia sp. (Labiatae)

خردل شهری

Khardal-i-shahrī, Tukhm-i-khardal (Teh., Ham.); the seeds.

Field 252; K.B. 337.

Tukhm-i-khardal is the Persian name for mustard seed and the seed of *Salvadora persica*, but in the above two specimens seeds of a *Salvia* have been supplied. The seeds are rounded, 1 mm. in diameter, grayish brown, with a minute, round umbilicus; a transparent mucilaginous coating is formed when they are soaked in water. The seeds are prescribed with bitter medicines.

Santalum album L. (Santalaceae)

سندل سفید

Sandal-i-safid (Teh.); white sandalwood.

Field 232; W.H.M.M. 150789.

These are pieces of the fragrant, white sandalwood of India. The important constituent of the wood is the volatile oil, of which it yields from 2 to 5 per cent. This contains about 90 per cent of the alcohol santalol. Sandalwood oil is used in perfumery, and in

medicine for its stimulant (irritant) and antiseptic action in the genito-urinary tract.

Saussurea Lappa C. B. Clarke (Compositae)

قستنج

Qust-i-talkh, Butinak (Teh.); Patchak (Beng.); Kutha Kushta patchuk (Hind.); *Costum amarum* (Ph. Pers.); Indian costus.

Ait.; Fl. Br. Ind. 3: 376; Schl.; Ph. Ind. 2: 296.

W.H.M.M. 150813; K.B. 338.

The soft, fragrant, whitish root comes from plants grown as a Crown monopoly in Kashmir, and is exported to Iran, India, and China. This ancient and valuable drug was called Arabian costus as it was carried to Turkey and Europe by the Arabs. The root occurs in cylindrical or twisted pieces, light colored, with an agreeable odor and a bitter and biting aftertaste. A second sample of Kust from Hamadan was a smaller root, spirally twisted and lighter in color. Chob-i-kut is the name of a plant used to adulterate costus root in Afghanistan. Various chemical principles have been separated from the root, some of which account for the violet-like odor: Costulactone isomeric with alantolactone costus acid, dehydrocostus lactone, and costol. Costus root is prescribed externally and internally for various complaints, and is taken locally to ward off the effects of snake and animal bites.

[**Semecarpus Anacardium** L. (Anacardiaceae)]

بالادر

Balādur (Teh., Isf.); Bhela, Bhilava (Hind.); marking nut.

Field 439; W.H.M.M. 150873.

[The marking nut tree inhabits the hotter part of India, Ceylon, and Burma. The black, obliquely cordate nuts contain within the pericarp a black, resinous, viscid, acrid juice which is used as marking ink. A local caustic and vesicant, the juice, when applied to the skin, causes intense pain and swelling. In small quantities, it is given for relief in rheumatic pains and leprosy affections.—Prepared like tea, it is also taken to relieve flatulence following severe piles (H.F.).

[**Sesamum indicum** L. (Pedaliaceae)]

سمن

Simsim (Iraq); Kunjad (Kurd.); Kundij (Turk.); Til, Jinjili, Gingelly (Hind.); til or sesame seed.

Field 128A, 52 (Iraq).

[Sesame is widely cultivated as a summer crop. The seeds, white, brown, or black, are used for garnishing cakes and sweetmeats and are eaten by the poor in times of scarcity. They contain about 50 per cent of a fixed oil which is an excellent substitute for olive oil or other salad oil in cooking. The oil cake is a cattle food. The oil is also the basis of most of the fragrant or scented oils—medicated oils prepared with various vegetable drugs.

In Baghdad, Rashi is the name given to a preparation of ground sesame seed after it has been soaked and roasted, which is used as an emollient, Rahishi (Ar.), Arwah-i-kunjad (Pers.).

Sesbania aculeata Poir. (Leguminosae)

Sesbaniyah (Iraq); Saisaban (Egy.); Rasin (Hind.); Akar, Majandri (Bal.); Jayanti (Beng.); *Sesbania* seeds.

Field 47 (Iraq).

[The plant has been introduced into Iraq and planted for wind-breaks. The seeds are sold in bazaars throughout India and Iran. They are dull grayish brown, oblong, 2 by 4 mm., smooth, hard, and bitter to the taste. The Hindus have a superstition that sight of the seeds will remove the pain of scorpion stings. They are used medicinally on account of their astringent properties. The seeds are beaten into a paste which is applied locally to cure eruptions.]

Sisymbrium Sophia L. (Cruciferae)

خاکشیرین

Khākshīr, Khākshīr-i-shīrīn (Teh.); Towdri, Khub-kalan, Khaksi (Hind.); the seeds.

Ait.; Schl.; Boiss. 1: 216; Ph. Ind. 1: 118, 121.

Field 4 (Isf.), 50; W.H.M.M. 150712.

These seeds resemble in size, shape, and color the drug Tukhm-i-khākshīr talkh, the bitter Khākshīr (*Erysimum* sp.), except that they are dull and not shiny. There are several kinds of cruciferous seeds known as "Towdri": pale, light brown, red, and black. The seed of *Lepidium Iberis* L., the Kasis of Iran, is one of them, and the seeds of *Matthiola incana* R. Br., from the Punjab and Sind, is another. The seeds are small, yellowish brown, 1 mm. in length, and become coated with transparent mucilage when placed in water. The drug is considered aphrodisiac, "fattening the body and purifying the blood."

—Taken with a little sugar and cold water it is a remedy for nausea, or is given in hot water for stomach pains; it is said to be harmless, even for children (H.F.).

Smilax China L., and **S. glabra** Roxb. (Liliaceae)

چوب چین

Chüb Chīnī (Ind. bazaars); Tu fu ling (Chin.); Raiz de China (Port.); Tuber Chinae; China root, Chinese sarsaparilla.

Schl.; Laufer 556; Colloquios; Ph. Ind. 3: 500.

W.H.M.M. 150773; K.B. 338.

[This root was once a famous remedy for the treatment of Morbus americanus (syphilis), and was first introduced into Europe by the returning sailors of Columbus, and into India by the sailors of Vasco da Gama. It is mentioned by Indian writers of the 16th century. Garcia da Orta traced the source of the drug to China and records a cure made in 1535. It was soon afterward introduced into Iran by the Portuguese. Saponin was found in the root by Kobert in 1911, but its therapeutical action is not considered very marked.

Solanum nigrum L. (Solanaceae)

تاجریزی

Tāj-i-rīzī (Teh.); Inab-ath-thalab, "fox's grapes"; Inab-ed-dib (Ar.); Karezgi (Bal.); black nightshade, wonderberry.

Achundow; Boiss. 4: 284; Ph. Ind. 2: 550; I.H.B.

Field 130A, 414; W.H.M.M. 150722; K.B. 339.

[This species of *Solanum* is a common weed in Iran, where the leaves are eaten as spinach, and the small, black fruits with yellow seeds are medicinal. The berries are eaten by the country people (G.). The Bote women employ the fruit as a cosmetic; they stick the fresh seeds on their cheeks to remove freckles and improve the complexion.

—Mixed with violet flowers, *Nymphaea alba* L., jujube, sebestan, and sugar, the fruits of *S. nigrum* are prepared like tea to soften the feces before giving a purgative, especially in typhoid fever (H.F.).

The fruits of bittersweet (*S. Dulcamara* L.), under the name of Sag-anjar, "dog's grapes," are among the drugs exported to India. They are considered laxative and are employed in chronic enlargement of the liver.

Solanum xanthocarpum Schrad. & Wendl. and **S. Melongena** L.

(Solanaceae)]

تخم باد نجان

Tukhm-i-bādanjān (Teh.); seeds of the wild eggplant.

Field 261.

[These plants occur throughout India. The stem and leaves are armed with strong prickles; the flowers are in racemes; and the berries are spherical, smooth, and marked with variegated, green and yellow stripes. The seeds are reniform, 2 mm. in diameter, compressed, and light brown in color. They are expectorant in asthma and catarrh.

Sorghum vulgare Pers. and **Andropogon Sorghum** Brot. (Gramineae)]

دهوره

Dhurah, Idhrah baidha (Ar.); Dari, Gowaar (Hind.); Baryadh dari (Turk.); Zuratspi (Kurd.); great millet.

Field 111 (Iraq).

[Giant millet is cultivated extensively as an irrigated summer cereal crop in the riverain areas between Basra and Mosul. During the past few years there has been an annual export of grain from Iraq amounting to between 30,000 and 50,000 tons. The grain is well liked by the people as a food (G.).

Spinacia oleracea L. (Chenopodiaceae)]

تخم اسناج

Tukhm-i-ispanāj (Teh.); Ispinākh (Iraq); Sag Palak (Hind.); spinach seeds.

Field 45; W.H.M.M. 150912.

[Spinach is cultivated in kitchen gardens in Iraq and Iran for its large, fleshy leaves which are eaten as a vegetable. It is sometimes confused with spinach beet (*Beta vulgaris* var.), which is much used as a substitute for spinach. The fruits are in green clusters, triangular, each angle terminating in two or more spines, the surface rugose and wrinkled. The fruits contain mucilage and alkaline nitrates, and are demulcent and diuretic, employed for fever and inflammation of the bowels.

The seeds of *Chenopodium capitatum* Aschers. are also sold under the above vernacular names.]

Stachys germanica L. (Labiatae)

Tuklejah(?) (Ham.); the flowers.

K.B. 339.

This woolly plant and its varieties are found in the Caucasus and in Europe. The drug consists chiefly of the sub-oblique, five-toothed calyces covered with tomentum, having the remains of flowers and stalks. It is given to relieve stomach disorders.

Stachys lavandulaefolia Vahl (Labiatae)

مرزنجوش

Marzanjūsh (Tab.); Mardan gusht, "men's ears"; Sansaq (Ar.); the leaves.

Achundow; Ait.; Ph. Ind. 3; Gilliat-Smith and Turrill, Kew Bull. 1930, 459.

W.H.M.M. 150833; K.B. 339.

This species of *Stachys* with purple flowers is found in Asia Minor, the Caucasus, Kurdistan, and Iran, and is one of the sources of an ancient Persian drug. Marjanjūsh is referred by Achundow to *Origanum Majorana* L. We can confirm Dymock in identifying it with *Zataria multiflora* Boiss. (q.v.), a plant which in India merits the appropriate indigenous name of Zatar. Gilliat-Smith remarks that the inflorescence is sold in the bazaars of Tabriz, and is made into an infusion for relieving spasms and stomach disorders.

Strychnos Ignatii Berg. (Loganiaceae)

باپتال

Pāptiyāl (Teh.); Papita (Ar., Hind., Bom.); Ignatia Amara; St. Ignatius' bean.

W.H.M.M. 150864.

These seeds from the Philippine Islands are in general use in drug shops in the East. They are ovoid, triangular or bluntly angular, and about an inch in length; the horny albumen is intensely bitter and contains the alkaloids strychnine and brucine. In native practice preparations of the seed are used in plague and other infectious diseases and in intercostal neuralgia.

Strychnos Nux Vomica L. (Loganiaceae)

کچولہ

Kuchūlah (Teh.); Fuluz mahi (Pers.); Kuchila (Hind.); nux vomica, seeds.

Ait.; Schl.; Ph. Ind. 2: 459; Fl. Br. Ind. 4: 90.

W.H.M.M. 150816; K.B. 339.

[*Nux vomica* or Kuchula seeds are frequently referred to in ancient Persian works. In the "Makhzan el Adwiya" they are said to have been used from very early times for paralysis. Called Azaraki by Indian Mohammedans, they are given for debility. The seeds are imported from India, and are known throughout Iran as a poison. Aitchison says, "The seed of the *nux vomica* is imported freely into these parts (northeast of Iran) as a valuable tonic, but it is chiefly employed by the nomad tribes for poisoning wolves and dogs, these animals frequently proving destructive to their flocks."

***Tagetes erecta* L. (Compositae)**

کل جعفری

Gul-i-ja'fari (Teh.); Ja'fari (Iraq); Gul gaindo (Bal.); Gul-jaferi (Hind.); Rojia (Port.); African marigold.

Field 86.

[Both the African marigold and the French marigold (*T. patula* L.) are cultivated in flower gardens for their orange-yellow blossoms and scented foliage. They were probably introduced into India by the Portuguese. The flowers are often worn as garlands during religious festivals. Sold in the bazaars in India and Iran, the dried flower heads are said to purify the blood.

***Tamarindus indica* L. (Leguminosae)**

تخم تمر

Tukhm-i-tamr (Teh.); Baz-i-tamar-hindi (Ar.); seeds of the tamarind.

Field 262.

[The seeds of the Indian tamarind tree are dark brown, shining, flattened, of an irregular outline, containing ivory-white cotyledons. Size is made from the seeds, and it appears that this preparation is used in Tehran as a plaster for boils (see "Tamarind Seed" by D. Hooper, *Agricultural Ledger*, No. 2, 1907).

***Tamarix gallica* L. var. *mannifera* Ehrenb. (Tamaricaceae)**

کز خونسار

Gaz-i-khünsār, Gaz-alafi, Gaz-anjabin, "tamarisk honey" (Teh.); Gaz-i-shakar, "tamarisk sugar"; tamarisk manna.

Ph. Pers.; Ait.; Boiss. 1: 778; Ph. Ind. 1: 161.

Field 13; W.H.M.M. 150881; K.B. 340.

[Aitchison collected in the Badghis samples of manna from this variety of *Tamarix*, which the natives distinguished from the ordinary species, *T. gallica*. The saccharine exudation of these plants is said to be collected only in southeastern Iran, in the district of Kerman, where small galls also are formed on the leaves. In other parts of Iran Gaz-anjabin is obtained from other species of tamarisk (see *T. pentandra*). Ehrenberg believes the sugar to be formed as a result of the punctures of *Coccus manniparus*. The sample from Tehran is a dried cake of confection wrapped in silver paper, probably a mixture of the manna with ordinary sugar.

Tamarix pentandra Pall. (Tamaricaceae)

کرمازج

Guezmazedj (Teh.); Guize khouncar, Hebbel asle (Schl.); manna.

[Tamarisk Manna, D. Hooper, Jour. As. Soc. Bengal, n.s. V, 1909, 31-36; Boiss. 1: 773.]

K.B. 340.

[The various species of tamarisk are the commonest shrubs or small trees found from Quetta to Balamtghab, and from Herat to Meshed, up to 3,000 feet. At least six species are widely distributed in Baluchistan, and two of them, *T. articulata* Vahl (Siah gaz) and *T. pentandra* (Shingir gaz), have been observed to yield a sweet gum. The latter is known to give large quantities of this saccharine secretion in the Helmand. The samples are similar; they are sweet, sticky, transparent, quite soluble in water, and become hard and opaque when kept, owing to the crystallization of the saccharose.

Taxus baccata L. (Taxaceae)

زرنب

Zarnab (Isf.); Barambi, Talispatra (Hind.); Himalayan yew.

Field 430.

[Zarnab is an Arabic name for an odoriferous drug and plant quoted by old writers on Eastern materia medica. The drug has been referred to various trees of the pine and fir group, particularly the yew and *Abies Webbiana* Lindl. (Ph. Ind. 3: 375). The present drug appears to consist of the staminate inflorescence of the yew, but other recorded specimens are mixtures of the leaves, branches, and

bark of a conifer. The drug is regarded as antispasmodic and is given in asthmatic affections.

Terminalia bellerica Roxb. (Combretaceae)

بليله

Balilah (Teh., Isf.); Balera (Hind.); Belleric myrobalans.

Ph. Pers.; Schl.; Ph. Ind. 2: 5; Fl. Br. Ind. 2: 446.

Field 424; K.B. 340.

This is an Indian tree, and because of its medicinal properties it bears the Sanskrit synonym Anīla-ghnaka or "wind killing." The belleric myrobalans of commerce are the fruits of this tree, and are imported into Iran from India. Mohammedan physicians regard them as astringent and digestive, and use them for making a lotion for sore eyes.—Myrobalans, mixed with cardamoms, are given in pills to cure general debility (H.F.).

Terminalia Chebula Retz. (Combretaceae)

هليله سیاه

Halilah-i-zard, Halilah-i-kābulī, Halilah-i-siyāh (Teh., Isf.); Har, Hara (Hind.); Hirda (Bom.); Haritaki (Beng.); Chebulic myrobalans.

Ph. Pers.; Schl.; Fl. Br. Ind. 2: 447; Ph. Ind. 2: 1.

Field 19, 407, 417; W.H.M.M. 150777; K.B. 341.

Myrobalans were known to the early Arabian and Greek writers, and several kinds were described. At the present time two varieties are found in every Eastern bazaar: (1) the young, unripe nuts which turn black on drying, Halilah-i-siyāh or black myrobalans; and (2) the mature nuts, which are larger and yellowish in color, called Halilah-i-zard or Halilah-i-kābulī. The first kind is used chiefly in medicine, and many fanciful properties are attributed to it.—Powdered and made into pills it is used as a strong purgative and to relieve stomach pains (H.F.).

The yellow myrobalans contain about 30 per cent of tannin and are employed as a tanning agent.

Teucrium Polium L. (Labiatae)

مریم نخودی

Maryam nukhūdī, "peas of Mary" (Teh.); Ja'ad (Iraq); Meriam Nekhodi, according to Schlimmer, is the Tehran name for *T. scor-dioides* Schreb. The Merian gole of the "Terminologie" is referred to

Salvia officinalis L., but according to Gilliat-Smith, this plant, although cultivated in gardens in Tabriz, has no local name and is not used by the natives.

Boiss. 4: 821; I.H.B.; Ph. Ind. 3: 125.

Field 130; W.H.M.M. 150799; K.B. 341.

This plant is the poley germander or polion of the Greeks. The drug consists of the small, woolly flowers, mixed with some stalks and leaves. It has the fragrance of thyme, and is given as an infusion for internal disorders—to relieve pains during pregnancy (H.F.). In Baluchistan *T. Stocksianum* Boiss. is called Kalpora, and is a remedy for fever.

***Thea sinensis* L. (Theaceae)**

چای سبز

Chā'ī sabz (Teh.); Chā (Hind.); green tea leaves.

W.H.M.M. 150820.

A sample of prepared green tea. Tea is imported in immense quantities, chiefly from southern Iran and India. Iranis are very fond of this beverage; prepared tea is sold in nearly every bazaar.

According to Laufer (pp. 553-554) "in Mongol, Turkish, Persian, Indian, Portuguese, neo-Greek, and Russian we equally find the word *čai*, based on North Chinese *c'a*. The Tibetans retain the Chinese word in the ancient form *ja* (*dža*)."

***Thymus Serpyllum* L. var. *Kotschyanus* Boiss. (Labiatae)**

کوشان شیرازی

Jōshan Shīrāzī (Teh.); Zātār (Syr., Iraq); Seetere (Schl.); Djūshā (Pers.); the herb.

Ait.; Boiss. 4: 556; Post; Schl.; Fl. Br. Ind. 4: 649; Ph. Ind. 3: 114.

Field 75A; K.B. 341.

This variety of thyme is a plant of Iran and Kurdistan. The leaves are rounded, cuneate, ovate to lanceolate, with prominent nerves below. The leaves are fragrant, and resemble those of *Zataria multiflora* Boiss., a plant which also has the name of Zatar. Post applies the name Zatar to all plants of the genus *Thymus*. Boissier, on the other hand, refers Zatar to *Origanum Maru* L., Zatar farisi to *T. capitatus* L., and Zaeteran to *T. decussatis* Boiss. It would thus appear that Zatar and Jōshan Shīrāzī are similar drugs, characterized by a thyme-like aroma. The leaves are carminative.

Tilia rubra DC. (Tiliaceae)

برگ تیول

Barg tiol (Teh.); floral leaves of the lime tree.

W.H.M.M. 150713.

The flowers of this Eastern lime or linden are not elsewhere referred to as medicinal, but are probably, like other plants of this genus, given for their mucilaginous and demulcent properties. The flowers of the European lime (*Tilia europaea*) are prescribed for catarrh and nervous complaints.

Trachydium Lehmanni Benth. (Umbelliferae)

شقافی

Shagāgi, Shekakul (Teh.); Chakha-khoul (Turk.); Chighaghole metri (Schl.); parsnip of the desert, root of wisdom.

Schl.; Post 368; Boiss. 2: 891; Ait.; Ph. Ind. 2: 136.

W.H.M.M. 150869; K.B. 342.

The roots of this and other umbelliferous plants are collected in Afghanistan and Iran and exported to India as a medicine. The root, the shape and size of a small carrot, is about 1 inch in diameter at the thicker end, tapering to a point. Internally it is white, starchy, friable, and sweetish to the taste. It is considered very valuable as a diet for improving the memory and increasing brain power. The name is applied to other stimulating roots eaten by women to increase their embonpoint. The roots of *Caucalis*, *Pastinaca*, *Eryngium*, and *Eremodaucus* are drugs of this class used as food for invalids.

Trachylobium Hornemannianum Hayne (Leguminosae)

سندلوس

Sandalūs (Ind. bazaars); gum copal.

W.H.M.M. 150742.

This resin of African origin is too well known as an article of commerce to require description. As a drug it is used in native practice as an astringent, anthelmintic, diuretic, and emmenagogue. Made into ointment it is applied to wounds to promote granulation.

Tribulus terrestris L. (Zygophyllaceae)

خار خشک

Khār-khasak (Teh.); Hasach (Iraq); Chota gokhru (Hind.); Tribolia (modern Gr.); small caltrops.

Achundow; I.H.B.; Fl. Br. Ind. 1: 423; Ph. Ind. 1: 243.

Field 253; W.H.M.M. 150849; K.B. 342.

This plant is found in the sandy deserts of northwestern India, where the fruits are collected for the market. As a drug it is mentioned by Dioscorides and Pliny and in the Bower manuscript. The fruit, the size of a small bean, has five cells, each of which is wedge-shaped and armed with four strong prickles. The seeds are oily and enclosed in hard, stony cells. The fruits are diuretic and are said to act as a charm in bladder troubles. Dulm-ul-hasak and Rughan-i-char-i-chesak are names for an oil prepared from the fruits and applied to relieve rheumatism.—Small caltrops are given as an infusion for gonorrhea (H.F.).

Trifolium alexandrinum L. (Leguminosae)

برسيم

Barsim (Iraq); seeds of berseem or Egyptian clover.

Field 31, 51 (Iraq).

This is a well-known fodder and green manure. Experiments have shown that it can be grown satisfactorily as a winter crop. The seeds are yellowish brown, smooth, oval, 2 mm. long.

Trifolium repens L. (Leguminosae)

تخم شدر

Tukhm-i-shabdar (Teh.); Shaftal (Punj., Bal.); Nafal, Nifil (Iraq); white clover seed.

Field 29 (Iraq); W.H.M.M. 150902.

Clover or trefoil grows in northern India, at an elevation sometimes of 10,000 feet in the Himalayas. The seeds are oval, brown or green, and are used for making cooling poultices for boils.

Trigonella Foeniculum L. (Leguminosae)

تخم شنبلیله

Tukhm-i-shambalilah (Teh., Ham.); Hulbah (Iraq); the seeds.

Shambalilah (Teh.); Methi (Hind., Bom.); the herb, fenugreek. Ait.; I.H.B.; Boiss. 2: 70; Post; Ph. Ind. 1: 402.

Field 27, 71A, 213; 16 (Iraq); W.H.M.M. 150749, 150795; K.B. 343.

Fenugreek is cultivated universally in gardens as a potherb, and in Egypt and Afghanistan as a food and fodder crop. The leaves

are occasionally used for poultices and in curries. The seeds are mucilaginous and have been known since antiquity for their medicinal properties, which are stomachic and cordial.—As an infusion they are given for menorrhagia (H.F.).

***Triticum vulgare* Vill. (Gramineae)**

کنم سفید

Gandum-i-safid, Gandum-ābī (Teh.); Kanim (Kurd.); Gehun (Hind.); Godumai (Tam.); wheat grains.

Nishāstah (Teh.); wheat starch.

Field 160, 273; 9, 26, 27, 35, 40, 42, 49, 56 (Iraq); 57A, 58A, 59A, 60A, 61A, 62A.

Wheat is one of the principal winter crops grown in cultivated areas throughout the country. Herodotus (III, 22) mentions only wheat as the staple food of the Persians at the time of Cambyses. Modern Irani primitive physicians use wheat starch as a dusting powder to allay the pain of burns and inflammation.

Guest (p. 102) records the following information: "*Triticum* (Gramineae). Wheat. Hintah, Bughdāi (Turk.), Ganim (Kurd.). One of the two principal winter crops grown extensively in the cultivated areas throughout the country; the other is barley. There are several indigenous spp. and many hundreds of local varieties. Wheat is grown on irrigation in the riverain areas of Lower Iraq and, more extensively, on rain in the 'daim' areas of the upper plains; it is also grown in the valleys of Kurdistan (up to alt. about 2,000 m.). There is in normal years a considerable export of grain from Iraq, denoting a surplus above the requirements of the inhabitants. Formerly, the grain had a bad name in the trade owing to the dirt and other impurities which it contained; it was classed as 'Persian' and fetched a poor price in the world markets. Of recent years a great improvement has taken place in the cleanliness and quality of the grain exported from this country and it is confidently hoped to establish a name for Iraqi wheat. To this end legislation has recently been introduced to encourage the propagation of 'Ajibah wheat (one of the Punjab wheats), which was issued by the Department of Agriculture a few years ago after trials had proved it to be superior to any other local or imported variety.

"Bread Wheat, *T. vulgare* Vill. Almost the only kind of wheat grown on irrigation in the riverain areas of Lower Iraq. In certain years it suffers badly from rust disease which takes a heavy toll of

the crop. This is one of the reasons for the growing popularity of the newly-introduced 'Ajibah, a variety highly resistant to rust. A certain amount of bread wheat is also grown on rain in the 'daim' areas of the north, where it is known as Hintah Qandahārī (N.).

"Macaroni Wheat, *T. durum* Desf. Hintah Khushnah. Much the greater portion of the 'daim' wheat in the north is of this type. It gives a higher yield, has greater resistance to drought and is more immune to rust than the local bread wheats. The grain of this type of wheat is harder and larger than the grain of bread wheat; but the bread made from it is of a poor quality. It is largely eaten in the form of Burghul (Kurd.), a kind of local porridge.

"Khorasan Wheat, *T. orientale*, and Polish Wheat, *T. polonicum*. Both these spp. have long hard grains known as Sinn-aj-jamal or Sinn-al-fil. Sometimes cultivated in the north.

"Dwarf Wheat, *T. compactum* L. Hintah walwal. One or two wild spp. of *Triticum* and of the grass, *Aegilops* (now generally included as a subsp. of this genus), are known to occur in Iraq. Of these the following may be mentioned:

"*T. dicoccoides* Koern. A specimen has been received from Jebel Sinjar, where it is said to grow on the hillside."

In the collections of the Rustam Agricultural Experimental Farm at Hinaidi near Baghdad, Iraq, the following varieties of wheat are represented:

- (a) *T. vulgare durum libicum*. Black wheat. Rustam No. 41. Field 15A. Origin Euphrates, Iraq.
- (b) *T. vulgare erytholenca*. Punjab B8. Rustam No. 43. Field 18A. Origin Punjab, India.
- (c) *T. vulgare albidum*. Linga No. 3. Rustam No. 141. Field 17A. Origin Australia.
- (d) *T. vulgare leucospermum*. U.S.A. Rustam No. 207. Field 16A. Origin Pusa, India.
- (e) *T. vulgare turcicum*. Ajibak. Punjab No. 8A. Rustam No. 210. Field 19A. Origin Punjab, India.
- (f) *T. vulgare albidum*. Clarendon wheat K. Rustam No. 602. Field 14A. Origin Australia.

During excavations at Kish and Jemdet Nasr in Iraq by the Field Museum-Oxford University Joint Expedition, samples of wheat and barley were found in pottery vessels belonging to the period approximately three thousand years before the Christian era. These grains,

preserved through being burnt, are difficult to identify with regard to their species. A summary of this discussion has been published by Henry Field, "Ancient Wheat and Barley from Kish, Mesopotamia," *Amer. Anthr.*, 34, No. 2, pp. 303-309. For further information on this subject the reader is referred to various publications by Nikolai Vavilov, Institute of Plant Industry, Leningrad, U.S.S.R.]

Tulipa montana Lindl. (Liliaceae)

فريونه

Frai-yōnah (Iraq); Lāla (Afg.); Govarikh, Wodak (Bal.); bulbs. Field 54.

The bulbs of this tulip of Iran, Baluchistan, and Afghanistan have brown, coppery skins. They are sold in the Mosul market as food (G.). The bulbs are eaten also in Baluchistan, where the leaves are a fodder for goats.

[**Uncaria Gambier** Roxb. (Rubiaceae)]

کات کلابی

Kāt-i-gulābī (Teh.); Chinai-katha (Bom.); extract, pale catechu. Field 208.

[This is a specimen of the pale catechu of commerce obtained from Singapore. In the form of cubes, 1 inch across, it is prepared from the leaves and stalks of the plant grown in the Malay States. It is very astringent, as it contains both catechin and tannin. In Tehran it is prescribed for coughs.

Veratrum album L. (Liliaceae)]

کندش

Kundush (Ham., Teh.); Kondochi (Schl.); hellebore root. Boiss. 5: 171.

Field 221; K.B. 343.

[White hellebore is a plant of Europe, Central Asia, and Japan. The root is mentioned as a drug in the herbals of Hippocrates and Galen. The rhizome is dark brown, cylindrical or slightly tapering, 2.5 cm. in diameter, with numerous scars of broken rootlets, whitish within. It contains a poisonous alkaloid, jervine. The root is one of the Irani poisons, and is used only externally, as a paste for headache and facial neuralgia.—It is also applied as a relief from nasal catarrh (H.F.).

Verbascum Thapsus L. (Scrophulariaceae)

مازريون

Māzaryūn (Teh.); Mahi zahraj, Bon tamaku (Ar.); Gidar tamaku (Hind.); great mullein.

W.H.M.M. 150758.

This mullein grows from the temperate Himalayas westward to Britain. The drug consists of broken stalks and thick, hairy leaves. The narcotic action of mullein on fish appears to be well known to the Arabs and Iranis, the meaning of Mahi zahraj being "fish poison." Mohammedan physicians prescribe it in gout and rheumatism in combination with aperients. Throughout Europe mullein has long had a reputation in the pulmonary diseases of cattle, on which account it bears the name of cow's lungwort.

Vetiveria zizanioides Stapf (*Andropogon muricatus* Retz) (Gramineae)

برمک

Barmakiyā, Bikh-i-wala (Pers.); Khas Khas (Hind.); Izkhir-i-jami (Ar.); Vetiver (Tam.); root of cuscus grass.

Field 5 (Isf.).

The use of these fragrant, wiry roots for medicinal purposes and in perfumery has been common in India for a long time. The roots emit a pleasant odor when moist, and for this reason they are woven into screens and mats (tatties) which hang over doors and windows to cool and perfume the atmosphere during the hot season. A paste of the root is applied to the skin to relieve oppressive heat of the body, and a cooling aromatic bath is prepared by adding some broken root to the water. The root yields a fragrant essential oil which commands a high price as a perfume (Otto Stapf, *Kew Bulletin*, 1906, 347-349).

Vicia Faba L. (Leguminosae)

باقلا

Bāghalā (Iraq); Banklent (Bal.); Bakla (Hind.); Baqilla, Baqlah (Turk.); Paglah (Kurd.); broad or horse bean.

Field 4, 56, 69 (Iraq).

This legume is a native of Iran and is now universally cultivated. The beans are a well-known vegetable and an excellent horse food. The shoots are said to be efficacious in rousing a drunkard from

stupor. The seeds are oblong, 24 by 18 mm. Those of the small variety are oblong, 8 by 5 mm., brown in color, with a white hilum. These seeds are exported from Egypt in large quantities for feeding horses.

Vigna Catjang Walp. (Leguminosae)

لوبيا

Lubia (Iraq); Mak (Bal.); Chowli (Hind.); Barbati (Beng.); cow pea.

Field 58, 93A; 50, 64 (Iraq).

The cow pea is cultivated as an irrigated summer crop and much grown on mud flats along the receding rivers in summer and autumn. The green pods are cooked and eaten as a vegetable and the seeds are eaten as a pulse. The seeds are recognized by their oblong shape, 10 by 7 mm., and white color with a brown or black spot or hilum on one side. The black-eyed variety is known in Italy under the name of *Faggiuola del occhio*.

Viola sp. (Violaceae)

گل بنفشه

Gul-i-banafshah (Teh.); flowers of violet.

Abu Mansur; Ph. Pers.; Ait.; Boiss. 1: 450; Post 118; Ph. Ind. 1: 141.

Field 8, 76; W.H.M.M. 150710; K.B. 343.

Violet flowers are regarded in Iran and the Punjab as a valuable medicine. The sweet violet (*V. odorata*) is stated to be the origin of the commercial article, but as the flowers are frequently broken and mixed with leaves and stalks, it is not possible to determine the species. The drug is astringent, demulcent, and diaphoretic, and mixed with lime juice and sugar, is administered as an infusion for fever and headache.

—Mixed with *Echium amoenum* Fisch. & Mey., *Nymphaea alba* L., *Cordia myxa* L., *Zizyphus vulgaris* L., as well as lime juice and sugar, *Viola* sp. is given in an infusion for headache, fevers (not malarial), and to soften feces before purgation (H.F.).

Vitis vinifera L. (Vitaceae)

کشمش غناب

Grapes: 'Inab (Iraq); Angur, Drakh (Hind.).

Raisins: Kishmish, Munakha (Pers.); fruit of the vine.

Field 63, Kishmish-askari; 266, Kishmish-i-sabzah; 267, Kishmish-i-dūgh; 99A, 100A, 101A, 102A, 103A, Pasteek.

[Grapes, in Sanskrit, Draksha, are noted by Susruta and Charaka; in the dried state they were used in medicine on account of their demulcent, laxative, and cooling properties. The raisins found in India are the sultanas from Kabul and Iran, some of which are very large and pale greenish yellow in color, called Angul Drakh; the black bloom raisins, Kala Drakh, from the same countries, are used for medicinal purposes; and an inferior kind called Munakha is like the pudding raisins sold in England. Pasteek of Baghdad is a confection of raisins and nuts made in Diarbekir and Kurdistan. Soo'juch is another confection of raisins and almonds made in Kurdistan and eaten in winter in place of fresh fruit.]

Withania somnifera Dunal (Solanaceae)]

بوزیدان

Būzīdān (Teh., Ham.); Asgandh (Hind., Guz.); Sekran (Syr.); Hajarat el dib, "wolf's tree" (Ar.); the root.

Boiss. 4: 287; Fl. Br. Ind. 4: 239; I.H.B.; Post; Ph. Ind. 2: 566; Kew and Pharm. Soc. Museums.

W.H.M.M. 150806; K.B. 343-344.

[This is an unarmed shrub with ovate, woolly leaves, inhabiting the south of Europe, Syria, Arabia, India, and Africa. The roots are long, tapering, light brown, with knotty crowns, plump, smooth, white internally, with a short, starchy fracture. The taste is mucilaginous and slightly bitter. From observations on the nature of this plant and the specific names *somnifera* and *hypnotica* given to it by botanists, it might be expected to be harmful to human beings. In Hamadan the root is considered a poison and in parts of Arabia animals refuse to graze on the plant. In Baluchistan, however, it is said to be a vegetable and fodder for goats. Duthie says the shrub is alterative and the root is given to horses. F. B. Power and A. H. Salway (*Proc. Chem. Soc.*, London, 1911) found evidence of an alkaloid and other crystalline principles in the root; but it contained no mydriatic alkaloid, and physiological tests failed to confirm the sedative and hypnotic properties attributed to it.]

Zanthoxylum Rhetsa DC. (Rutaceae)

دهن باز دهن بته

Dahan-bastah, Dahan bastah-bāz (Teh.); Fagara Avicennae.

Field 172; W.H.M.M. 150760.

The fruits of this tree are oval or nearly spherical, of a bright reddish brown color, finely wrinkled, opening when ripe, disclosing a black, shining seed. The Iranis call it Kababah-i-dahan kushadeh, "open-mouthed cubebs," on account of the gaping appearance of the carpels. The taste is at first pleasant like lemon, but afterward pungent, producing much the effect of pyrethrum on the palate. The fruits contain a volatile oil and resins, and are used as a tonic in fever, dyspepsia, and cholera.—They are also given for cystitis in gonorrhea (H.F.).

Zataria multiflora Boiss. (Labiatae)

آب شم

Ab-i-sham, Afsin, Marzanpish, Zatar (Teh.); Sa'atar (Ind. bazaars); Izgun, Isghand (Bal.); the herb.

Boiss. 4: 561; Post; I.H.B.; Ph. Ind. 3: 114.

Field 173, 182; W.H.M.M. 150708, 150833; K.B. 344.

[This small plant is found in the hills of Muscat in Oman, Iran, and Baluchistan. The species is allied to *Z. bracteata*, which sometimes bears the same vernacular names. Marzanpish, the name it has in Tehran bazaars, is also applied to another fragrant labiate (see *Stachys lavandulaefolia*). The small, thick, orbicular, and glandular-dotted leaves have the odor of thymol, and are credited with the carminative properties of thyme and mint.—They are given as an infusion for premature labor pains and rupture (H.F.).

Zizyphora tenuior L. (Labiatae)

کا کوتی

Kākūti (Teh.); Kahkuti (Bal.); Mishk-i-taramashia (Ind. bazaars); the herb.

Boiss. 4: 587; Ait.; I.H.B.; Ph. Ind. 3: 115.

W.H.M.M. 150865; K.B. 344.

[This is a small labiate with spiked flowers found in Iran, Baluchistan, and Afghanistan. Aitchison says it is much used in medicine owing to its strong aroma of peppermint and thyme. In Baluchistan the plant is taken to allay fever, and the seeds, powdered and mixed with buttermilk, are used in cases of dysentery. In Tehran the herb is employed as a cordial and stomachic.

***Zizyphus vulgaris* L. (Rhamnaceae)**

عناب

'Unnāb, Barg-i-unnāb (Teh.); 'Unnāb (Iraq); Ber (Hind.); jujube, fruits and leaves.

Achundow; Boiss. 2: 12; Ph. Ind. 1: 350; Post.

Field 12; 79A; W.H.M.M. 150801; K.B. 344.

The indigenous form of the jujube is a shrub, rarely a tree, in the hills from the Badghis eastward to Kashmir. It is cultivated in all orchards for its fruit, which is eaten by the natives, especially on journeys; this, Aitchison thinks, may account for the spread of the tree throughout Asia along caravan routes. The fruits, which are sweet and wholesome, are the origin of the confection called jujube. They are imported into India, and are used as a demulcent and medicinally from the Persian Gulf to China, where they exist in many varieties and constitute one of the important fruits of the country. The leaves of the jujube tree are eaten with catechu as an astringent, and are made into a poultice to promote the suppuration of boils.

DRUGS OF MINERAL ORIGIN

Alum

زاج سفید

Zāj-u-safīd (Teh.); Sheb (Bagh., Iraq); Spati-kari (Sans.); Zamchi (Turk.); Phitkari, Phataki (Hind.).

Field 250; 126A.

Crystals of alum sulphate, with a styptic, sweetish taste. Alum is used to stop bleeding, to settle turbid water, and in the native tanning industry.—It is also a whitening agent and used as an astringent (H.F.). It is obtained in commercial quantities from Aksu and Kuchar in eastern Turkestan.

Antimonium sulphate

کل سرمه

Kuhl or Surmah (Pers.); Arjan, Surma-ka-pathar (Hind.); black sulphide of antimony, Kermes mineral, kohl.

Field 10 (Isf.), 40A.

Kohl or powdered black antimony is used throughout the East for blackening the eyelids. Introduced originally by the native doctors, hakims, as a remedy for eye diseases, it is now used by women as a cosmetic to improve their appearance. Lampblack is sometimes sold to take the place of the mineral compound.—A detailed summary of the use of kohl in southwestern Asia will form part of a forthcoming publication (H.F.).

Armenian earth

کل ارمنی

Gil-i-armanī (Pers., Hind.); Hajr-el-armeni (Ar.); Armenian bole or earth, ocher.

Field 196, 235; 139A.

Armenian clay consists of oxide of iron mixed with carbonate of lime. Clay of bright red contains a small amount of lime, but lighter-colored clays effervesce strongly with acids and contain less oxide of iron. Armenian bole, either by itself or mixed with red sandalwood and spices, is painted on the face and body to relieve skin affections, boils, and sores. It is one of the earths eaten by pregnant women. In Afghanistan this habit is so frequent that the term "Gil-khwar" is applied to clay or chalk eaters (see Laufer, Berthold, "Geophagy," Field Mus. Nat. Hist., Anthro. Series, 18, No. 2, 1930).

Arsenic trisulphide

زرنیخ

Zarnikh, Zārnickh-i-dandan (Teh.); Zārnikh-zard (Isf.); Hartal (Hind.); Haritala (Sans.); yellow sulphide of arsenic, orpiment.

Field 230; W.H.M.M. 150825.

Orpiment is obtained from the Hayana Mountains, Iran, and from China. It occurs in massive or lamellar, golden yellow crystalline pieces, sometimes mixed with gray or black metallic portions. It is used as an alterative and nervine tonic.—Mixed with lime it is employed as a depilatory (H.F.).

Calcium sulphate

گچ کا شان

Gach-i-kāshān (Teh.); Guetcha (Schl.); Gil-i-dschar (Achundow, Ph. Pers.); Sanjirahut (Sans.); Sufid pathar (Hind.); gypsum.

Field 215; W.H.M.M. 150893.

Gypsum is a white crystalline mineral, transparent, and slightly soluble in water. Some bazaar specimens are mixed with mineral impurities.

Plaster of Paris is powdered gypsum deprived of its water of crystallization by heat.—To stop epistaxis it is dissolved in water and rubbed on the forehead (H.F.).

Copper oxide

لاسرکھ

Lāsurbh (Teh., Isf.); copper oxide, oxidized copper.

Field 151, 427; W.H.M.M. 150822.

Copper oxide is heavy, gray or black metal with crystalline fracture. It is said to be prepared "by placing the metal in a mouse's stomach and burning," and the resulting compound is used directly for ophthalmia. "It is an adhesive application for the eyes to relieve swelling." Lāsurbh is also regarded as a form of kohl, or preparation of antimony, which ladies apply to their eyelids and brows, not only to give them a beautiful black but to smooth away excrescences.

Edible clay

کلی سرشور

Field 228, 251.

Gil-i-sarshūr (Teh., Afg.) is the name given by Aitchison to the edible clay of Afghanistan. The term is applied to a clay of general domestic utility. In Iran it is the name of an earth used by women for cleansing the hair.—The two samples from Tehran were stated to be used as “hair cosmetic” and “complexion cosmetic” (H.F.).

Lead carbonate

Safid āb-i-shaikh (Teh.); Isfedaj (Ar.); Sufeda (Hind.); carbonate of lead, white lead, painters' whitening.

Field 166.

A soft, white, heavy powder, this is used in making ointment of lead carbonate, which acts as a local sedative and astringent.

Lead oxide

مرداسنگ نقرئی

Murdā sang-i-nugra'i, Murdā sang-i-tilā'i, Murda sang, “death stone” (Teh.); Sindur (Bom.); litharge.

W.H.M.M. 150704, 150772.

The specimens have a similar appearance; they consist of pieces of fused metal with a grayish brown or pinkish exterior. They are probably samples of the unfinished product of the action of heated air on melted lead, and not proper litharge.

Potassium nitrate

سورة قلم

Shūrah-i-qalam (Teh.); Shorah (Hind.); niter, saltpeter.

Field 231; W.H.M.M. 150854.

Obtained on a large scale from the saltpeter earth of the Punjab and Bihar, crude saltpeter occurs in small, dirty crystals, mixed with much common salt. Shūrah-i-qalam is pure saltpeter in white, crystalline, pen-shaped prisms (qalam=pen).—Niter or saltpeter is prescribed for difficult urination and for gonorrhea (H.F.).

Russian clay

کل داغستان

Gil-i-dāghistān (Isf., Teh.).

Field 9 (Isf.), 227.

This is a grayish white clay, a compound of silica and alumina, in heavy lumps, soapy to the touch and adhesive to the tongue. The clay is brought from Daghestan in the northeastern part of the

Caucasus, and is used with other medicaments and applied to infected parts of the body. It is also taken internally as a tonic in pregnancy, or, as Schlimmer remarks, to satisfy the "appétit des femmes enceintes."

Shāf-i-mamitā (Teh.)

شاف مامیتا

W.H.M.M. 150725.

These are small rolls of a mineral preparation about 2.5 to 3.5 cm. in length, pointed at one end. They consist of chalk, which dissolves in acid, and a quantity of red clay left insoluble. From the name Shāf, meaning suppository or clyster, they are probably used for this purpose.

Sigillated earth

کل مخدوم

Gil-i-makhdūm (Teh.); Tukhm-makhtum (Punj.).

Field 246; 86 (Iraq).

These are two forms of sigillated earth, sealed clay or Lemnian earth. The sample from Tehran is a rounded cake of light reddish clay with white specks, 2 cm. in diameter and 1.5 cm. thick; on the upper portion there is a depression in the center made by a stamp. The clay is smooth to the touch and contains no carbonate of lime. For use in medicine it is moistened with water and applied to purulent wounds.

The samples from Iraq are circular lumps of white clay of a larger size, 3.2 cm. in diameter and 1.2 cm. thick. Each is marked above by three thumb impressions, with checkered lines below. The powdered clay is used as a desiccant for dusting abraded surfaces.

The literature on the Sacred Sealed Earth of Lemnos is very extensive. The earth is described by Dioscorides (A.D. 40) and Galen (A.D. 131–201), and was used in Europe until the 17th century. An interesting account is given in Pomet's "Histoire des Druges" (1694), and perhaps the most recent review of the subject is "Terra Sigillata: a Famous Medicament of Ancient Times," by C. J. S. Thompson (1914). Laufer ("Geophagy," pp. 164–166) gives an account of terra sigillata from Lemnos (cf. Armenian earth).

Other medicinal clays represented in the Field collection are: Gil-i-berz (263), a cosmetic used to counteract excessive perspiration;

Gil-i-gazwin (247), a clay eaten by pregnant women; and Gil-i-batuni (258), a siliceous powder used by painters.

The following is a list from other sources of edible and medicinal clays met with in Iran and India.

Gil-i-gubradi. Cyprus clay.

Gil-i-igritus. Cretan earth.

Gil-i-khurasani. Edible chalk.

Gil-i-misri or *Karkooti*. Egyptian earth or Nile mud taken from bed of river.

Gil-i-shamus. Samian earth (according to Dioscorides the Greeks used the earth of Samos as a means of stopping the vomiting of blood—Laufer, "Geophagy," p. 109).

Gil-i-zard. Yellow clay from Istanbul.

Chunniah (from China, lime). A soap-like, earthy substance obtained from lakes near Halla, eaten by women of Sind.

The subject of eating clays is of ethnological as well as medicinal interest. An attempt to deal with the subject from these points of view will be found in a paper on "Earth-eating and the Earth-eating Habit in India," by D. Hooper and H. H. Mann (*Mem. Asiatic Soc. Bengal*, Calcutta, 1906, pp. 240–270).

Sodium carbonate (crude)

نمک قلیاب

Namak, Qalyāb (Teh.); washing soda.

W.H.M.M. 150843.

This is a white, alkaline salt, either thrown up as an efflorescent deposit on the soil (*Sajji mati*), or prepared from the ashes of marine plants. It consists of sodium carbonate, containing much chloride and sulphate of sodium, and insoluble matter.

Sulphur

گوگرد زرد

Gūgird-i-zard, Gūgird-i-akhmar (Teh.); Gogut (Yark.); Gandhak (Hind.).

Field 218, 241; W.H.M.M. 150731.

Yellow sulphur in powder and crystalline masses is said to come from the Mount Demavend district in Iran.—Sulphur ointment is used for skin complaints and for secondary syphilis (H.F.).

DRUGS OF ANIMAL ORIGIN

Nummulites sp. (Foraminifera)

عَدَسُ الْمَلِكِ

'Adasu 'l-mulk, Shāhdānej-i-'adasī (Teh.); Sang-i-shadnaj (Afg.); Shudnuj udsee (Ar.); Satanj, Samgh nadh (Punj.).

Field 158; W.H.M.M. 150852.

These are small, lens-shaped or button-shaped fossils, varying from 4 to 12 mm. in diameter. The name Adas refers to the seeds of the lentil, *Lens esculenta*, which the smaller stones resemble. They consist principally of calcium carbonate and act as an antacid. According to Honigberger the hakims administer the powdered fossils for eye diseases and for ulcers. On the authority of the "Doctrine of Signatures" these and other fossils were administered in former days on account of their resemblance to the products of disease.—Powdered with *Punica Granatum* L. and Sumaqh-i-shah, they are applied to painful gums (H.F.).

Corallium rubrum Lam. (Anthozoa)

شاخِ مَرَجَان

Shākhah-i-marjān (Teh.); Sang-i-marjan (Hind.); Bussud (Ar.); Prabala (Sans.); red or gem coral.

Field 169; W.H.M.M. 150879.

Coral is obtained from the Red Sea, Persian Gulf, and Arabian coast. It is formed by coral polyps, which have the power of taking up lime from sea water and building this into a skeleton. Coral, therefore, consists principally of calcium carbonate. Both the red coral and the organ-pipe coral (*Tubipora*) are used in medicine; they are reduced to powder and given as a tonic, and to check vomiting and acidity resulting from dyspepsia and biliousness.

Cidaris sp. (Echinoidea)

حَجَرُ الْيَهُودِ

Hajaru'l-yahūd, Sang-i-yahuda (Pers.); Pathar-ka-ber (Hind.); Dugre bore (Bom.); Lapis jadaicus (Ph. Pers.); Jews' stone.

W.H.M.M. 150886.

This fossil echinoid consists of the petrified spines of a sea urchin, found in the Jurassic deposits of the Salt Range, Punjab. Extravagant ideas prevail as to the origin of these fossils, which some suppose

to be petrified fruits; the name they bear in Delhi, Pathar-ka-ber, signifies the fruits or stones of the jujube tree. The stones are oval, pointed at both ends, 3.5 cm. long and 2 cm. in diameter. They contain 95 per cent of calcium carbonate. These stones are sold all over northern India, Iran, Syria, and Palestine. They are said to be useful for healing wounds, and, internally, for flatulence and diarrhea.

Cypraea moneta L. (Gastropoda)

صدف

Sadaf, Wuda (Ar.); Khar mahra (Pers.); Cowrie, Sipi (Hind.); cowrie shells.

Field 269A.

These well-known porcelaneous shells from the Mediterranean and Persian Gulf are used throughout the East for making ornaments, and at one time were a means of barter or medium of exchange. They consist chiefly of calcium carbonate, and in medicine are used as an antacid, alterative, and expectorant. The shells also serve as charms against the Evil Eye for babies, horses, and machines (H. F.).

Larinus maculatus Fald. (Coleoptera)

Yielding Tréhala manna; described under the name of the host-plant, *Echinops persicus*.

Bee's wax (Hymenoptera, Apoidea)

موم

Mūm (Teh.); Moma (Hind.); Cera alba; white wax.

Field 216, 260.

White wax is sold in the shops and used for plasters and ointments.

"Camphor candle" (Mūm-i-kāfūri) is a specimen of a crudely made wax candle in the composition of which camphor has been incorporated to diffuse a pleasant odor when burning.

Bombyx fortunatus Hutton (Lepidoptera)

پيله ابریشم

Abrisham, Pīlāh abrisham (Teh.); Pileh, cocoon; Rēsham, silk; Pat (Beng.); Resham-ki-keri (Duk.); cocoons of the silk moth.

W.H.M.M. 150821.

The cocoons of the silk moth or silk worm are said to be styptic and tonic, and are generally administered with other astringents.

Burnt, the ashes are given internally in profuse menstruation and chronic diarrhea.

Under the name of Abrīsham, white silk, cut into small pieces, is given in Ajmere as a remedy for impotence (Irvine).

Otoliths of fish (Percomorphi, Sciaenidae)

Sang-i-sar-i-māhī (from Sang, "a stone"; Sar, "a head"; Mahi, "fish"; an allusion to the belief among the natives that the stone is found in the head of a fish), "poa teeth" (Ind.).

W.H.M.M. 51699.

Otoliths are semi-crystalline bodies composed of carbonate of lime, found in the ear sacs of fish. These concretions are sold in Delhi and other cities in northern India. They resemble in color and form the human incisor teeth, being white and smooth, and having both surfaces convex. The concretions are powdered and given for urinary diseases, chiefly in the suppression and retention of urine (Khory).

Tortoise eggs (*Testudo horsfieldii* Grey and *T. graeca*. Chelonia)

تخم لاک پشت

Tukhm-i-lāk-pusht, "eggs of the hard-backed one" (Teh.); Sur-kūk (Afg.); Lek-poshte (Schl.); tortoise eggs.

W.H.M.M. 150899.

These are globular, orange-colored, waxy bodies, 2 cm. across, disintegrating in water, leaving a yellowish powder, insoluble, with oily globules on the surface. Eggs of the tortoise are used by the Bruhies (Afghanistan) whipped up with water and smeared over the pustules as a remedy to prevent pitting from smallpox (Bellew). In Assam the eggs are also eaten and used medicinally. The eggs and flesh are said to be aphrodisiac. People of the Makran coast (Baluchistan) have a custom of tying a piece of turtle shell to any animal having a stoppage of urine.

Milk curds from *Bos indicus* (Ruminantia)

قرقروت

Qar-i-qurūt (Teh.); Karūt, Krūt (Afg.); dried oxygal, hardened cheese.

Field 238.

Qurūt or Karūt occurs in round balls or cakes of varying shapes made from the milk of cows, buffaloes, or goats. It is usually

obtained by evaporating sour buttermilk, pressing out the whey in bags, by hand, and drying the solid curd in the sun. These cakes are used by Afghans and residents of the black tents of Helmand, who carry them on their tours as a favorite article of diet. When required, the cakes are mixed with water, brinjal fruits and bread added; the whole forms an admirable dish. The Qar-i-qurūt from Tehran is a blackish brown mass, acidulous and salty to the taste, largely soluble in water; it is very similar to meat extracts sold in America and Europe.—The preparation is used as a soup following vermifuge treatment (H.F.).

Kashk Kashk (Kurd.).

Field 61.

These are balls of casein, butter, and salt, prepared from milk. They probably represent the "Pleasant Food" (Khushk horāk) flavored with asafoetida, used in Afghanistan (Aitchison).

Camel's flesh, dried from *Camelus dromedarius* L.; single-humped or Arabian camel

کوهان شتر

Kūhān-i-shutur (Teh.); camel's hump.

Field 140.

The specimen is a piece of yellowish white, dried, fibrous flesh from the hump of a camel. This peculiar drug is directed to be mixed with fat and made into an ointment for piles. The Tatars use the hump cut into slices, which, placed in tea, serve the purpose of butter. Camel's meat is eaten by Greeks and Iranis; the flesh of the young dromedary is considered by Arabs to be equal to veal. Ainslie states that the rennet of the camel, which the Iranis term Punir-mayeh-shutur, is placed among their aphrodisiacs; Honigberger calls the substance *Camelinum coagulum* and says it is highly esteemed by Arabian doctors.

Bezoar stones from *Capra aegagrus* Gmel.; Persian wild goat

پادزاهر

Pādzahr (Pers.); Fadzehre heyvani (Schl.); Gorochan (Hind.); bezoar stone.

W.H.M.M. 199302.

The bezoar stone appears to have been first used as a medicine by the Arabian physician Avicenna. Razis in his "Continens" describes

it fully, and extols its good qualities as an alexipharmic. Linschoten devotes a chapter to the description of "Bezar stones and other stones good against poyson" and quotes da Orta's account of the origin of this biliary concretion which came from Iran. Similar stones are obtained from the cow, goat, wild boar, antelope, porcupine, and camel. That obtained from the camel is the cheapest, but that from the Persian wild goat is considered the most efficacious. The specimen cited came from Shiraz.

Goats' droppings

مامیز کری

Māmīz, Māmīz-i-kirī (Teh.).

Field 224; W.H.M.M. 150735.

The specimens consist of lumps of fecal matter, from 1 to 1.5 cm. across. Broken and examined with a lens, they were seen to be composed principally of vegetable débris. This is unusual as a drug, and not recorded in ordinary medical works of the East, but in Tehran is said to be rubbed on the chest for bronchitis.

Sheep's stomach, dried

مایه بره

Māyah-i-barrah (Isf.); sheep's stomach.

Field 8 (Isf.).

This specimen is a dried portion of a sheep's stomach, containing the active principle of the gastric juice. The name Māyah refers to ferment, leaven or rennet, and Panir māyeh, "cheese producer." Rennet for preparing cheese is also obtained in the East from the stomach of hare, dog, or pig, as well as from that of the sheep and calf.

Mummy

میائی

Mūmiyāi, Mūmiyā (Pers.); Silajit (Hind.); Silajatu, "rock sweat" (Sans.); Khatmolt, Mashana churro (Bal.); Asphaltum Persicum; Asphaltum Punjabinum; Osteocolla (Lat.).

This is one of the most ancient medicines of Iran and northern India, and there has been considerable confusion regarding its origin and nature. There is no doubt that it was early associated with dead or embalmed bodies from Egyptian tombs, which were used

in medicine in Europe in the Middle Ages, though often subject to adulteration (Budge, Sir E. A. W., "Mummy: Chapters on Egyptian Funereal Archaeology," London, 1893).

Another animal source has been found in the Khatmolt of Baluchistan, which contained a large proportion of urea. This confirms the direct evidence of a local medical dictionary that "Mummiat is the inspissated urine of the mountain goat."

The third source of Mummy is the exudation of a bituminous substance from a rock; the Indian name Silajit or "rock sweat" expresses the phenomenon. The Mumiat obtained as a secretion from the Mummy mountain of Iran has been described by Chardin, Kämpfer, Ouseley, Le Brun, and other travelers, and these all point to the fact that the substance is a variety of bitumen, asphalt, or allied hydrocarbon. R. Seligmann of Vienna published a pamphlet containing extracts from rare Persian manuscripts regarding this substance. At one time the King of Persia collected the product from one of the mountains near Behbahan and Darab, enclosed it in silver boxes, and distributed it with great care to those in need of this wonderful medicine.

Samples of Mumiat received lately in the Wellcome Historical Medical Museum are those of a variety of asphalt or mineral pitch. Some are black, soft, and sticky, and may be drawn out into long threads, while other samples are black, hard, and brittle.

In the light of modern therapeutics we may anticipate a decline in the reputation of Mumiat of Iran and the Silajit of India, and, like the Hiraceum of the Cape of Good Hope, these once famous remedies will soon be relegated to medicines of a past age.

Cuttle fish bone from *Sepia officinalis* L. (Cephalopoda)

کف دریا

Kaf-i-daryā, "foam of the waters" (Ar.); Samudraphena (Sans.); Os Sepiae, cuttle fish bone.

Field 85A; W.H.M.M. 150837.

Cuttle fish bone is the internal skeleton of the common cuttle or squid; it is used as a polishing material, and reduced to powder is employed in medicine as an antacid. It is often brought by returning pilgrims from Mecca, and hence is looked upon as a very important medicine. The Indian cuttle fish bone has the following composition: calcium carbonate 87.66, calcium sulphate 0.76, organic matter and water 9.3, iron oxide and alumina 0.46, magnesia and alkalis 1.7, silica 0.1, and phosphoric anhydride 0.02, in 100 parts.

SOME PRESCRIPTIONS FROM ISFAHAN, IRAN

HEADACHE

Morning:

'Unnāb	jujube	2 pieces
Gul-i-arvanah	wild violet	2 misqals
Marzanjūsh	white rose	2 misqals
Nabat	crystallized sugar	5 misqals
Tukhm-i-gishnīz	coriander seed	2 misqals

برای درد سر صبحانه
عنب . گل اردانه . رز فقرش . نبات . تخم گشنیز
از هر یک دو مثقال بگیرد ، از نبات ۵ مثقال باید باشد

Evening:

Nabat	crystallized sugar	5 misqals
Tukhm-i-gishnīz	coriander seed	2 misqals
Usgundūs	germander	2 misqals

Mix the above herbs in each remedy, add some water, and boil. Distil and drink.

عصرانه
نبات . تخم گشنیز . اسفوندها
از هر یک دو مثقال بگیرد ، از نبات ۵ مثقال باید باشد

HEADACHE

Ab-i-gishniz	coriander water
Maghze hastah-i-ālbālū	sour cherry kernel
Sandal-i-surkh	sandalwood
Sandal-i-zard	aloe
Tiriak	opium

Powder the roots of the above herbs and apply by rubbing over the affected area.

برای درد سر
آب گشنیز . مغز هسته آبلار . سندل سرخ . تریاک

این دو را در آب شسته و دیشته به جالبه

PLEURISY AND PNEUMONIA

Luabe behdūnah	juice of quince
Mūm-i-kāfūri	camphorated wax
Roghan-i-badam	almond oil

Mix some of each and apply by rubbing on affected parts.

برای زات الریه و زات الحجب

لعب بیدونه . سرم کافوری . روغن بادام .

مقداری از هر یک مخلوط کرده و بمالند . این دوا را مالیده میشد

CHEST AND STOMACH PAINS

Morning:

'Unnāb	jujube	5 pieces
Behdūnah	seed of quince	2 misqals
Gul-i-banafshah	flowers of violet	2 misqals
Roghan-i-badam	almond oil	2 misqals
Samgh Arabi	gum arabic	2 misqals
Sebestan	sebestan	5 pieces
Shakar-i-safid	white sugar	2 misqals
Tāj-i-rizī	felon wort	2 misqals

برای درد معده و سینه صبحانه

غلب . بهدونه . گل بنفشه . روغن بادام .

سمن عود . پستان . شکر سفید . تاجریزی .

از هر یک دو مثقال و از پستان و غلب ۵ عدد

Evening:

Behdūnah	seed of quince	2 misqals
Maghze tukhm-i-kadū	gourd seed	2 misqals
Roghan-i-badam	almond oil	2 misqals
Shakar-i-safid	white sugar	2 misqals

Mix, boil, and add half a misqal of almond oil (after distillation) in each of the above two remedies.

عصرانه و رخصاً

بهدونه . منزه تخم کدو . روغن بادام . از هر یک دو مثقال

DYSENTERY

Bārhang	orange	½ misqal
Rīshah-i-khatmī	root of marshmallow	
	flower	2 misqals
Tāj-i-rīzī	felon wort	2 misqals
Shakar-i-safīd	white sugar	2 misqals
Roghan-i-badam	almond oil	2 misqals
Tukhm-i-hummāz	wild sorrel	½ misqal
Kahraba	topaz	2 nukhuds

For bleeding feces; after boiling add almond oil and take internally.

دو سینار یا
 بارهنگ . . ریشه نخعی . تا جیزی . شکر سفید . روغن بادام
 تخم خماض . کهر با . از هر یک از این دواها دو مثقال
 کهر با دو نخود و بارهنگ و تخم خماض از هر یک نیم مثقال

HEMORRHOIDS

Rīshah-i-anjabār* root of snakeweed

Heat slightly and rub on affected area.

* Root of snakeweed (*Euphorbia pilulifera*), Australian snakeweed or cat's hair; employed in asthma, hay fever, coryza, and other respiratory infections, and also in angina pectoris.

دوا برای بیرون آمدن بواسیل

ریشه انجبار این دوا را کمی مالند . بواسیل بخارج

HEMORRHOIDS

Gul-i-gāv-zabān	oxtongue flower	2 misqals
Tukhm-i-tarraḥ	leek seed	2 misqals
Gaz-anjabin	manna	7 misqals
Magl ejrig	mixture of aloes, amber, sandalwood, and gum	2 misqals

Mix, boil, and take internally.

ددر برای رفع بیدن آمدن برادر خونی
کل گاد زبان . تخم تره . گزگین . متعل رجوق
از هر یک دو مثقال و ۱ از گزگین ۷ مثقال بشه

Zarda tukhm-i-murgh	yoke of egg
Kūhān-i-shutur	hump of camel
Maghze galam gao	cow's synovia
Roghan-i-badam	almond oil

Mix the constituents, heat, and apply to entire body.

ددر برای تسکین روی بواسیل
زرده تخم مرغ . کوهن شتر . مغز قلم گاو . روغن بادام .
دینه را نیم گرم کرده جاد میکنه . بر روی بدن می مالند .

HEMORRHOIDS

Aksīr-i-turkī

Asiatic calamus

Tarrah khushk

dried leek

These are burned under the patient's feet.

برای رفع بردن کهن بواسیل بادی
اکسیر ترکا . تره خشک . دینهار ازیر پای ددانش میکنند

HEMORRHAGE

Māzū-i-sabz

green gallnut

Zāj-u-safīd

white alum

The gallnut is ground and sprinkled on the wound. The alum is rubbed into the wound.

ددارای نه کردن خون

مازدی بنز . زاج سفید . مازوردا سائیده ردی

زخم پاشنه . زاج رازرمانه

NOSEBLEED

Shazenj	blackish, red colored, fragile stone often used medicinally
Kahraba	topaz
Rishah-i-marjan	root of coral
Adas	lentil

Grind well, add some spider web, and apply to nose. Application of ice water on the head, forehead, or the hands is also highly recommended.

دوا برای بند آوردن خون دماغ
 شاذنج . کهرابا . ریشه مرجان . عدس . لوبنهار
 ساییده با قدری پنیر و تار عنکبوت به دماغ میگذارند

MENSTRUATION

Gul-i-gāv-zabān	ox-tongue flower	2 misqals
Maghze hastah-i-ālbālū	sour cherry kernel	2 misqals
Pust-i-pistah	pistachio peel	2 misqals
Nabat	crystallized sugar	2 misqals
Roghan-i-badam	almond oil	2 misqals
Tabāshīr	chalk	2 nukhuds
Pādzahr	bezoar	2 nukhuds

Mix the ingredients, boil until reduced to 5 misqals of sugar, and eat.

دول برای حصه
گل گاوزبان . ستر هسته آبلو . پوست پسته . نبات .
روغن بادلم . تباشیر . پازهر . زهر یک دوشقال
و از تواشیر د پازهر ۲ نخود و شکر ۵ شقال . بوشنیده
و سفورنه

EXCESSIVE BLEEDING DURING MENSTRUATION

Māzū-i-surkhtah

burned oakapple

Khūn-i-siyāvash

dragon's blood

Barg-i-mūrd

leaf of myrtle

Pust-i-anar

peel of pomegranate

Dip a woollen rope into the boiled pomegranate peel; pound the herbs, and into this dip the soaked woollen rope; apply to the clitoris until all the blood has been absorbed.

دراجهت زیادى خون مريض

مازوى سرفقه . خون سيدش ن . برگ مررد پوت کنار .

دنيا را زم کرده قبيله پيشى را در آب پوت کنار که جوش بنده کن

گذارد و بعد ليخ قبيله را در کن دوا سیکه زننه . و بخود سیکه زننه

پس لذت بکند اين کار دو سه مرتبه کرده خون آسنى بنه

مى کيه .

DELAYED MENSTRUAL PERIOD

Abhil	seed of juniper berries	2 misqals
Rātiyanah	fennel	2 misqals
Zahrah gao	cow's liver	2 misqals
Tukhm-i-mūrd	ant seed	2 misqals

Pound the ingredients, dip a wet, woolen cloth into the mixture and apply internally.

دو برابر ای کشردن خون میخی

دبیل . راجینه . زهره گاد . تخم مرمر . دودار
نرم کرده . پشم تر را در این دودا گذاشته بخود میگیرند . از هر یک
دو شقال باشد

ABORTION

Abhil	seed of juniper berries
Pust-i-mar	snake skin

After the above medicine is placed on the fire, the woman squats over the fumes until the abortion takes place.

بجفت اسقاط بخین

دبیل . پوست مار . دینهار را زیر پای مادر کن بپزد
کوش می کنند .

CONTRACEPTION

(a) Anghoreh

berry

Swallow daily one-half nukhud of the prepared pill.

دو برای کبستن شدن
روزی نیم نخود کفتوزه را حب کرده و بخورند

(b) Sunbi Ulagh

hoof of donkey

Grind it, spread on a cloth, and use as an enema. The foregoing should be used three days after menstruation has begun. Men take no precautions.

برای کبستن شدن
سبب اللع خوب می بیند و روی کهنه مالیده و بخود مسکند و در
این سبب اللع را باید ببالند. این دو کار را باید فقط سه روز
بعد از آنکه میخی شده بکنند. مالیده و خوردن را.

CHILDBIRTH

(a) Roghan-i-badam almond oil

Drink 4 misqals of the oil mixed with 2 cups of hot water. This makes delivery very easy.

(b) Mishk musk
Nabat crystallized sugar

Mix some of each; prepare as tea and drink. The mother must be attended by an intelligent nurse.

دول بزینکه منورده بزایه برلی رفع سختی زایش
چهار مثقال روغن بادام باد فحن آب گرم باد بهند
یا اینکه مشک رو بنات دم کرده باد میهند . نزد زن
قابه دارا خوب و فیهی باید باشد

IMPOTENCY

Abrisham-i-kham	raw silk
Shagagul	wild carrot
Bahman-i-surkhu safid	white and red bahman
Tudri surkhu safid	sumac
Jalghūsa	nut resembling pistachio
Maghze funduk	filbert nut
Maghze badam	almond kernel
Narjil	coconut
Maghze pistah	pistachio kernel

Mix the ingredients with honey and eat 2 misqals before inter-course.

دوا برای تقریت با *

دریشتم خام . شق قن . هبن سرخ و سفید . تودری سرخ

و سفید . صلفوزه . مغز بادام . نارجیل . مغز پسته .

عل را همچون دست کرده دو شق قن قبل از صحت سوزنه

RHEUMATISM

Gul-i-gāv-zabān	oxtongue flower	2 misqals
Būzīdān	fattening drug	2 misqals
Maghze aklil	kernel of garland	2 misqals
Surinjān	wild saffron	2 misqals
Nabat	crystallized sugar	2 misqals

Boil the ingredients and drink.

دو درباری رفع روماتیسمی

گل گاو زبان . بزیه زن . مغز اکلیل . سرنجان .

نات . دزهر یک دو شغال گرفته میوشت نه دمنورنه .

Gudi salib

Surinjān

Hastah-i-ālbālū

Tiriak

Ab-i-gishnīz

wild saffron

pit of sour cherry

opium

coriander water

Mix well and apply externally.

قود صلیب . سرنجان . هسته آبلو . تریاک . آب کشنه
 با هم مخلوط کرده بپزند .

RHEUMATISM

Roghan-i-bazralbenock	sowing seed oil
Roghan-i-kirdū	walnut oil

Mix well and apply externally.

روغن بذرالنک . روغن گردو . باهم مخلوط کرده و محی مالند
 اریضه برای روماتیسمی

FRACTURED BONES

Roghan-i-mūm	wax oil
Rūnās	madder
Zarda tukhm-i-murgh	yoke of egg

Mix some of each, warm, and place over the fracture. After the fracture is reduced, apply a piece of wood to keep the limb straight, i.e. a splint.

روغن موم . زرده تخم . انبیا را نیم گرم کرده
 روی شکستگی استخوان می بپزند . روغن موم از همه بهتر است
 برای دستخوانهای شکسته

HAIR RESTORER

Kundur

Juniper gum

Roghan-i-gul-i-surkh

oil of red rose

Mix well and rub into scalp.

دو برابر ایسکه بری سرده نرینزد
 کندر . روغن گل سرخ . از هر یک قدری گرفته مخلوط کرده
 می مالند

DEPILATORY

Maghze kala kufand

sheep's brain

Samgh Arabi

gum arabic

Roghan-i-ziatūn

olive oil

Mix and apply to body. For men and especially for women.

دو برابر ایسکه بری سرده همد در نیاید
 مغز گوسفند . سمق عربی . روغن زیتون . هر یک قدری
 گرفته مخلوط کرده میمالند .

SNAKEBITE

No true remedy.

Make a deep incision with a knife and place a piece of burning charcoal in the open wound.

برای مارگزیده
ددای برای دهن که مخصوص باشد معوم نیست

ALPHABETICAL LIST OF NATIVE NAMES WITH LATIN EQUIVALENTS

Aabb-el-harar (Teh.)	<i>Juniperus excelsa</i> Bieb.
Abhil (Teh.)	<i>Juniperus excelsa</i> Bieb.
Abir (Pers.)	<i>Crocus sativus</i> L.
Ab-i-sham (Teh.)	<i>Zataria multiflora</i> Boiss.
Abrisham (Teh.)	<i>Bombyx fortunatus</i> Hutton
Abu Suwaif (Ar.)	<i>Hordeum</i> sp.
Acoron (Gr.)	<i>Acorus Calamus</i> L.
Adas (Turk.)	<i>Lens esculenta</i> Moench (also p. 194)
'Adas-i-talkh (Teh.)	<i>Indigofera Roxburghii</i> Jaume
Adas mar (Bagh.)	<i>Lens esculenta</i> Moench
'Adasu 'l-mulk (Teh.)	<i>Nummuliites</i> sp.
Adhafr-aj-jian (Iraq)	<i>Astragalus hamosus</i> L.
Adhafr-ash-shaitan (Iraq)	<i>Astragalus hamosus</i> L.
Affaz (Teh.)	<i>Quercus infectoria</i> Olivier
Afsant-el-bahara (Ar.)	<i>Artemisia maritima</i> L.
Afsantin (Teh.)	<i>Artemisia vulgaris</i> L.
Afsantin-i-hindi (Ar.)	<i>Artemisia vulgaris</i> L.
Afs-el-batum (Tri.)	<i>Pistacia Khinjuk</i> Stocks
Afsin (Teh.)	<i>Zataria multiflora</i> Boiss.
Aftab gardan (Teh.)	<i>Helianthus annuus</i> L.
Aftimün	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Afyun (Iraq)	<i>Papaver somniferum</i> L.
Agalactie (Schl.)	<i>Lecanora esculenta</i> Eversm.
Agirgarhā (Teh., Isf.)	<i>Anacyclus Pyrethrum</i> DC.
Ajees-aafs (Ar.)	<i>Quercus infectoria</i> Olivier
'Ajibah (Punj.)	<i>Triticum vulgare</i> Vill.
Ajibak	<i>Triticum</i> sp.
Ajil-i-turki (Teh.)	<i>Acorus Calamus</i> L.
Ajmud (Hind.)	<i>Apium graveolens</i> L.
Ajowan (Hind.)	<i>Carum copticum</i> Benth. & Hook.
Ajwain (Hind.)	<i>Carum copticum</i> Benth. & Hook.
Ajwain-ka-phul (Ind.)	See <i>Carum copticum</i> Benth. & Hook.
Akalkara (Hind.)	<i>Anacyclus Pyrethrum</i> DC.
Akar (Bal.)	<i>Sesbania aculeata</i> Poir.
Aketi (Ham.)	<i>Astragalus hamosus</i> L.
Akhrot (Hind.)	<i>Juglans regia</i> L.
Aksir-i-turki (Teh.)	<i>Acorus Calamus</i> L.
Akulla (Ar.)	<i>Commiphora opobalsamum</i> Kunth
Alaf-khareg (Afg.)	<i>Crataegus orientalis</i> Bieb.
Alashi (Ind.)	<i>Linum usitatissimum</i> L.
Alfabaca (Port.)	<i>Ocimum Basilicum</i> L.
Al-kanna (Ar.)	See <i>Onosma echinoides</i> L.
Alkikenji (Ar.)	<i>Physalis Alkekengi</i> L.
Alsi (Ind.)	<i>Linum usitatissimum</i> L.
Alü (Teh.)	<i>Prunus institia</i> L. var. <i>bokharensis</i>
Alü-bokhara (Teh.)	<i>Prunus institia</i> L. var. <i>bokharensis</i>
Alucha (Hind.)	<i>Prunus domestica</i> L. var. <i>Juliana</i>
Alüchah (Teh.)	<i>Prunus domestica</i> L. var. <i>Juliana</i>
Ambari (Duk.)	<i>Hibiscus cannabinus</i> L.
Amlaj (Ar.)	<i>Phyllanthus Emblica</i> L.
Amla morabba (Turk.)	<i>Phyllanthus Emblica</i> L.

Ammeos (Ph. Pers.).....	<i>Carum copiticum</i> Benth. & Hook.
Amulah-i-suftah (Teh.).....	<i>Phyllanthus Emblica</i> L.
Amulah-mugashshar (Isf.).....	<i>Phyllanthus Emblica</i> L.
Andiz otu (Turk.).....	<i>Inula Helenium</i> L.
Anduz (Ham.).....	<i>Inula Helenium</i> L.
Anghinar (Turk.).....	<i>Cynara Scolymus</i> L.
Angul Drakh (Ind.).....	<i>Vitis vinifera</i> L.
Angüm (Teh.).....	<i>Acacia Senegal</i> Willd.
Angur (Hind.).....	<i>Vitis vinifera</i> L.
Angur-i-kauli or kawali (Iraq, Pers.).....	<i>Loranthus Grewinkii</i> Boiss. & Bunge
Anila-ghnaka (Sans.).....	<i>Terminalia bellerica</i> Roxb.
Anisün (Teh.).....	<i>Pimpinella Anisum</i> L.
Anitum (Yunani).....	<i>Peucedanum graveolens</i> Benth. & Hook.
Anjabar-i-rumi (Pers.).....	<i>Polygonum Bistorta</i> L.
Anjar (Iraq).....	<i>Prunus domestica</i> L. var. <i>Juliana</i>
Année (Fr.).....	<i>Inula Helenium</i> L.
Antchibun (Tab.).....	<i>Pimpinella Anisum</i> L.
Anzarut (Ar.).....	<i>Astragalus fasciculaefolius</i> Boiss.
Aola amla (Hind.).....	<i>Phyllanthus Emblica</i> L.
Arab qosi (Turk.).....	<i>Glossostemon Bruguieri</i> Desf.
Arak-badiani (Schl.).....	<i>Pimpinella Anisum</i> L.
Arak Hail (Bagh.).....	<i>Elettaria Cardamomum</i> Maton.
Arakta chandana (Sans.).....	<i>Pterocarpus santalinus</i> L.
Ardi-shauki (Ar.).....	<i>Cynara Scolymus</i> L.
Arjan (Hind.).....	<i>Antimonium Sulphidum</i>
Arpā (Turk.).....	<i>Hordeum</i> sp.
Arwah-i-kunjad (Pers.).....	<i>Sesamum indicum</i> L.
Arzan (Pers.).....	<i>Panicum miliaceum</i> L.
Asal-alsus.....	<i>Glycyrrhiza glabra</i> L.
Asalia (Bom.).....	<i>Lepidium sativum</i> L.
Asārūn (Teh.).....	<i>Asarum europaeum</i> L.
Asbaghul (Pers.).....	<i>Plantago ovata</i> Forsk.
Asbarg (Iran).....	<i>Delphinium Zalil</i> Ait. & Hemsl.
Aschna (Ar.).....	See <i>Rocella Montagnei</i> Bél.
Asfar-i-makki (Teh.).....	<i>Cymbopogon Schoenanthus</i> Spreng.
Asgandh (Hind., Guz.).....	<i>Withania somnifera</i> Dunal
Asil-a-krasb (Afg.).....	<i>Apium graveolens</i> L.
Aspand (Kurd.).....	<i>Peganum Harmala</i> L.
Asphaltum Persicum.....	Mummy
Asphaltum Punjabinum.....	Mummy
Aspust (Bal.).....	<i>Medicago sativa</i> L.
Aswarg (Iran).....	<i>Delphinium Zalil</i> Ait. & Hemsl.
Atasi (Ind.).....	<i>Linum usitatissimum</i> L.
Atractus (Gr.).....	<i>Carthamus tinctorius</i> L.
Avartin (Sans.).....	<i>Helicteres Isora</i> L.
Azarak (Ind.).....	<i>Strychnos Nux Vomica</i> L.
Azkar (Teh.).....	<i>Cymbopogon Schoenanthus</i> Spreng.
Baberang (Hind.).....	<i>Embelia Ribes</i> Burm.
Bābūna.....	<i>Anthemis Wiedemanniana</i> Fisch. & Mey.
Bābūnah (Teh.).....	<i>Matricaria Chamomilla</i> L.
Babunaj.....	<i>Anthemis Wiedemanniana</i> Fisch. & Mey.
Babunaj (Pers.).....	<i>Matricaria Chamomilla</i> L.
Bach (Punj.).....	<i>Acorus Calamus</i> L.
Bādām-i-talkh (Teh.).....	<i>Prunus Amygdalus</i> Stokes var. <i>amara</i> Baill.

Badian (Pers.)	See <i>Foeniculum vulgare</i> Mill.
Badian (Ar.)	See <i>Pimpinella Anisum</i> L.
Badian-i-rumi (Teh.)	<i>Pimpinella Anisum</i> L.
Bād-i-ranjah būyah (Teh.)	<i>Dracocephalum Moldavica</i> L.
Bād-i-ranjah-būyah (Teh.)	<i>Asperugo procumbens</i> L.
Bādiyān-i-khatā'i (Pers.)	<i>Illicium verum</i> Hook. f.
Badiyān-i-sabz (Teh., Ham.)	<i>Foeniculum vulgare</i> Mill.
Badrandj-boia	See <i>Asperugo procumbens</i> L.
Badrendj-bou-yih (Schl.)	<i>Dracocephalum Moldavica</i> L.
Badrish-bu (Tab.)	<i>Dracocephalum Moldavica</i> L.
Badroudge ibieze (Schl.)	<i>Ocimum canum</i> Sims
Badyan (Afg.)	<i>Foeniculum vulgare</i> Mill.
Bāghalā (Iraq)	<i>Vicia Faba</i> L.
Bahār-i-nāranj (Teh.)	<i>Citrus sinensis</i> (L.) Osbeck
Bahman-i-pīch (Teh.)	<i>Helicteres Isora</i> L.
Baibun (Mosul)	<i>Matricaria Chamomilla</i> L.
Bajindak (Afg., Hind.)	<i>Lepidium Draba</i> L.
Bakayan (Hind.)	<i>Melia Azedarach</i> L.
Bakla (Hind.)	<i>Vicia Faba</i> L.
Balādur (Teh., Isf.)	<i>Semecarpus Anacardium</i> L.
Balasan (Ar.)	<i>Commiphora opobalsamum</i> Kunth
Balchar (Afg.)	<i>Nardostachys Jatamansi</i> DC.
Balera (Hind.)	<i>Terminalia bellerica</i> Roxb.
Balīlah (Teh., Isf.)	<i>Terminalia bellerica</i> Roxb.
Bālingū (Ham.)	<i>Lallemantia Royleana</i> Benth.
Bālingū shahrī (Teh.)	<i>Lallemantia ibirica</i> F. & M.
Bālingū-shirāzī (Teh.)	<i>Lallemantia Royleana</i> Benth.
Balūt (Teh.)	<i>Quercus persica</i> Jaub. & Spach
Bango (Port.)	<i>Hyoscyamus reticulatus</i> L.
Banj barri (Iraq)	<i>Hyoscyamus reticulatus</i> L.
Banklent (Bal.)	<i>Vicia Faba</i> L.
Banoi	<i>Anthemis Wiedemanniana</i> Fisch. & Mey
Bans lochan (Hind.)	<i>Bambusa arundinacea</i> L.
Baphalli (Hind.)	<i>Corchorus olitorius</i> L.
Baqilla (Turk.)	<i>Vicia Faba</i> L.
Baqlah (Turk.)	<i>Vicia Faba</i> L.
Barambi (Hind.)	<i>Taxus baccata</i> L.
Barbati (Beng.)	<i>Vigna Catjang</i> Walp.
Bardane (Teh.)	<i>Arctium Lappa</i> L.
Barg-i-gāv-zabān (Teh.)	<i>Echium sericeum</i> Vahl
Barg-i-hind Irān (Teh.)	<i>Butea frondosa</i> Roxb.
Barg-i-livās (Isf.)	<i>Rheum Ribes</i> L.
Barg-i-mūrd (Teh.)	<i>Myrtus communis</i> L.
Barg-i-nāranj (Isf.)	<i>Citrus sinensis</i> (L.) Osbeck
Barg-i-quitārān (Teh.)	<i>Chrozophora verbascifolia</i> Juss.
Barg-i-sādhaḡ (Teh.)	<i>Cinnamomum Cassia</i> Blume
Barg-i-unnāb (Teh.)	<i>Zizyphus vulgaris</i> L.
Barg tiol (Teh.)	<i>Tilia rubra</i> DC.
Bārhang (Teh.)	<i>Plantago major</i> L.
Barhi	<i>Phoenix dactylifera</i> L.
Bārījah (Teh.)	<i>Ferula galbaniflua</i> Boiss.
Bar-i-tang (Bal.)	<i>Plantago major</i> L.
Bariz (Teh.)	<i>Ferula galbaniflua</i> Boiss.
Barmakiyā (Pers.)	<i>Vetiveria zizanioides</i> Stapf
Bār ranjūbah (Teh.)	<i>Asperugo procumbens</i> L.

Barsim (Iraq).....	<i>Trifolium alexandrinum</i> L.
Baryadh dari (Turk.).....	<i>Sorghum vulgare</i> Pers.
Basal (Ar.).....	<i>Allium Cepa</i> L.
Basarak Katrin (Pers.).....	<i>Linum usitatissimum</i> L.
Basfaij (Ind. bazaars).....	<i>Polypodium vulgare</i> L.
Bas-fayij (Teh.).....	<i>Polypodium vulgare</i> L.
Basilikon Kuminon (Gr.).....	<i>Carum copticum</i> Benth. & Hook.
Bazbaz (Pers.).....	<i>Myristica fragrans</i> Houtt.
Baz-i-tamar-hindi (Ar.).....	<i>Tamarindus indica</i> L.
Bazrak (Ham.).....	<i>Linum usitatissimum</i> L.
Bazr-el-fujl (Ar.).....	<i>Raphanus sativus</i> L.
Bazr-i-banj (Teh., Ham.).....	<i>Hyoscyamus reticulatus</i> L.
Bazr ul Kattan (Achundow).....	<i>Linum usitatissimum</i> L.
Bazrul khasa (Ar.).....	<i>Lactuca sativa</i> L.
Bdellium (Hind.).....	<i>Commiphora Mukul</i> Engl.
Bedanjir.....	<i>Ricinus communis</i> L.
Bekh (Ait.).....	<i>Gypsophila paniculata</i> L.
Bekh-i-sumbul (Pers.).....	<i>Nardostachys Jatamansi</i> DC.
Bekh-sus.....	<i>Glycyrrhiza glabra</i> L.
Benj (Ar.).....	<i>Hyoscyamus reticulatus</i> L.
Ber (Hind.).....	<i>Zizyphus vulgaris</i> L.
Berengue Kaboli (Schl.).....	<i>Embelia Ribes</i> Burm.
Berij sadri Gilan (Teh.).....	<i>Oryza sativa</i> L.
Bernooty (Iraq).....	See <i>Nicotiana Tabacum</i> L. and <i>N. rustica</i> L.
Bhela (Hind.).....	<i>Semecarpus Anacardium</i> L.
Bhilava (Hind.).....	<i>Semecarpus Anacardium</i> L.
Bibi (Bal.).....	<i>Pyrus Cydonia</i> L.
Bid-anjubin (Afg.).....	<i>Salix fragilis</i> L.
Bide Knecht (Achundow).....	<i>Salix fragilis</i> L.
Bidend jireh khatai.....	<i>Croton Tiglium</i> L.
Bid-khisht (Teh.).....	<i>Salix fragilis</i> L.
Bihidana (Pers.).....	<i>Pyrus Cydonia</i> L.
Bikh-anjubaz (Punj.).....	<i>Polygonum Bistorta</i> L.
Bikh-i-banafshah (Teh.).....	<i>Iris spuria</i> Pall.
Bikh-i-halimun (Teh.).....	<i>Asparagus officinalis</i> L.
Bikh-i-shankarān (Isf.).....	<i>Conium maculatum</i> L.
Bikh-i-wala (Pers.).....	<i>Vetiveria zizanioides</i> Stapf
Bin-i-talkh (Isf.).....	<i>Indigofera Roxburghii</i> Jaume
Biranj mishk.....	<i>Calamintha graveolens</i> Benth.
Birinjasaf (Ind. bazaars).....	<i>Achillea Santolina</i> L.
Birinj-i-kābuli (Teh., Isf.).....	<i>Embelia Ribes</i> Burm.
Birinj-i-sadri (Teh.).....	<i>Oryza sativa</i> L.
Bizousha dishi and erkek (Turk.).....	<i>Plantago major</i> L.
Bizr dinbil (Iraq).....	<i>Plantago major</i> L.
Bizre Kattane (Schl.).....	<i>Linum usitatissimum</i> L.
Bol (Hind., Bom.).....	<i>Commiphora Molmol</i> Engl.
Bol shiah (Hind.).....	<i>Aloe Perryi</i> Baker
Bonduk-i-hindi (Ar.).....	<i>Caesalpinia Bonducella</i> Roxb.
Bon tamaku (Ar.).....	<i>Verbascum Thapsus</i> L.
Bughdāi (Turk.).....	<i>Triticum</i> sp.
Bui madaran (Punj.).....	<i>Achillea Santolina</i> L.
Bundaq (Iraq).....	<i>Corylus Colurna</i> L.
Būqnāq (Teh.).....	<i>Glossostemon Bruguieri</i> Desf.
Burghul (Kurd.).....	<i>Triticum durum</i> Desf. (p 182)
Buski (Bal.).....	<i>Lepidium Draba</i> L.

Bussud (Ar.)	<i>Corallium rubrum</i> Lam.
Butinak (Teh.)	<i>Saussurea Lappa</i> C. B. Clarke
Buzghanj (Ham., Isf.)	<i>Pistacia Khinjuk</i> Stocks
Büzidân (Ham., Teh.)	<i>Wilhania somnifera</i> Dunal
Buzz-ul-karaphs (Ar.)	<i>Apium graveolens</i> L.
C'a (N. Chin.)	<i>Thea sinensis</i> L.
Cai (Russian)	<i>Thea sinensis</i> L.
Camphire (Syr.)	<i>Lawsonia alba</i> Lam.
Chā (Hind.)	<i>Thea sinensis</i> L.
Chab roman (Bagh.)	<i>Punica Granatum</i> L.
Chagzī (Iraq)	<i>Juglans regia</i> L.
Chahār tankhūsh (Teh.)	<i>Pistacia integerrima</i> Stew.
Chahār-tukhmah (i.e. four seeds)	<i>Plantago major</i> , <i>Alyssum campestre</i> , <i>Cordia Myza</i> , <i>Pyrus Cydonia</i> (p. 98)
Chā't sabz (Teh.)	<i>Thea sinensis</i> L.
Chakha-khoul (Turk.)	<i>Trachydium Lehmanni</i> Benth.
Chaltuk (Kurd.)	<i>Oryza sativa</i> L.
Chana (Hind.)	<i>Cicer arietinum</i> L.
Charmaghy (Pers.)	<i>Juglans regia</i> L.
Chasm (Ham., Teh.)	<i>Cassia Absus</i> L.
Chasm-i-khurūs (Pers.)	<i>Abrus precatorius</i> L.
Chatlanguch (Ham.)	<i>Pistacia integerrima</i> Stew.
Chighaghole metri (Schl.)	<i>Trachydium Lehmanni</i> Benth.
China (Hind., Sans.)	<i>Panicum miliaceum</i> L.
Chinai-katha (Bom.)	<i>Uncaria Gambier</i> Roxb.
Chini (Chin.)	See <i>Saccharum officinarum</i> L.
Chiresh	<i>Eremurus Aucherianus</i> Boiss.
Chir zadi (Schl.)	<i>Lecanora esculenta</i> Eversm.
Chitra (Bom.)	<i>Plumbago rosea</i> L.
Chitrak (Hind.)	<i>Plumbago rosea</i> L.
Chitraka (Sans.)	<i>Plumbago rosea</i> L.
Chob-i-kut (Afg.)	<i>Saussurea Lappa</i> C. B. Clarke
Chota gokhru (Hind.)	<i>Tribulus terrestris</i> L.
Chowli (Hind.)	<i>Vigna Catjang</i> Walp.
Chüb Chini (Ind. bazaars)	<i>Smilax China</i> L. and <i>S. glabra</i> Roxb.
Chughak	<i>Prosopis Stephaniana</i> Kunth
Chuk-andar (Hind.)	<i>Beta vulgaris</i> L.
Chukundar (Turk.)	<i>Beta vulgaris</i> L.
Chuli (Botes)	<i>Prunus Armeniaca</i> L.
Chunniāh	Sigillated Earth
Costum amarum (Ph. Pers.)	<i>Saussurea Lappa</i> C. B. Clarke
Cowri (Hind.)	<i>Cypraea moneta</i> L.
Cummun (Syr.)	<i>Cuminum Cuminum</i> L.
Cuscuta (Lat.)	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Dahan-bastah (Teh.)	<i>Zanthoxylum Rhetsa</i> DC.
Dahan bastah-bāz (Teh.)	<i>Zanthoxylum Rhetsa</i> DC.
Dairi	<i>Phoenix dactylifera</i> L.
Dalik (Ar.)	<i>Rosa hemisphaerica</i> Herm.
Dall (Ind. bazaars)	<i>Lens esculenta</i> Moench
Damaverah (Ham.)	<i>Rosa hemisphaerica</i> Herm.
Dam-el-akhwain (Ar.)	<i>Dracaena Cinnabari</i> Balf.
Dam-i-ālbālū (Teh.)	<i>Prunus Cerasus</i> L.
Daramanah (Teh.)	<i>Artemisia maritima</i> L.
Dārasini (Ar.)	<i>Cinnamomum Cassia</i> Blume

- Dār-chīnī (Isf.)..... *Cinnamomum Cassia* Blume
 Dārī (Hind.)..... *Sorghum vulgare* Pers.
 Darūnaj-i-akrabī (Teh., Ham.).... *Doronicum Pardalianches* L.
 Darvunedge eghrebi (Schl.)..... *Doronicum Pardalianches* L.
 Datura (Hind.)..... *Datura Stramonium* L.
 Davālah (Ham.)..... *Roccella Montagnei* Bél.
 Dawalak (Achundow)..... See *Roccella Montagnei* Bél.
 Dhanya (Hind.)..... *Coriandrum sativum* L.
 Dhupa..... *Boswellia Carterii* Bird.
 Dhurah (Ar.)..... *Sorghum vulgare* Pers.
 Dibk (Ar.)..... *Loranthus Grewinkii* Boiss. & Bunge
 Digal..... *Phoenix dactylifera* L.
 Digh-dighane (Isf.)..... *Celtis australis* L.
 Djūshā (Pers.)..... *Thymus Serpyllum* L.
 Doronic (Gr.)..... *Doronicum Pardalianches* L.
 Doronicum Graeci (Ph. Pers.)..... *Doronicum Pardalianches* L.
 Drakh (Hind.)..... *Vitis vinifera* L.
 Draksha (Sans.)..... *Vitis vinifera* L.
 Dudhi (Ind. bazaars)..... See *Citrullus vulgaris* Schrad.
 Dugre bore (Bom.)..... *Cidaris* sp.
 Dukhn (Iraq)..... *Panicum miliaceum* L.
 Dulm-ul-hasak..... See *Tribulus terrestris* L.
 Dža (Chin.)..... *Thea sinensis* L.

 Ela (Sans.)..... *Amomum subulatum* Roxb.
 El-sābūniyeh (Ar.)..... *Gypsophila paniculata* L.
 Enula Campana (Med. Lat.)..... *Inula Helenium* L.
 Epitymon (Gr.)..... See *Cuscuta planifolia* Ten. & *C. hyalina* Roth
 Erok Chatma (Achundow)..... *Althaea ficifolia* Cav.
 Erok Chatma (Bagh.)..... *Althaea rosea* L. (p. 88)
 Erok Hail (Bagh.)..... *Elektaria Cardamomum* Maton.
 Erok orab kuzzi (Iraq)..... *Glossostemon Bruguieri* Desf.
 Erva dos (Dymock)..... *Pimpinella Anisum* L.

 Fadzehre heyvani (Schl.)..... *Capra aegagrus* Gmel.
 Faranj mishk..... *Calamintha graveolens* Benth.
 Fāsūliyah (Iraq)..... *Phaseolus vulgaris* L.
 Filfil ahmer (Ar.)..... *Capsicum frutescens* L.
 Filfil-i-surkh (Teh.)..... *Capsicum frutescens* L.
 Filfil mūyeh (Teh.)..... *Capsicum frutescens* L.
 Findak (Hind.)..... *Corylus Colurna* L.
 Findaq (Iraq)..... *Corylus Colurna* L.
 Flores Puniceae granati (Ph. Pers.).. *Punica Granatum* L.
 Folusi (Yark.)..... *Cassia Fistula* L.
 Foveh (?) (Ham.)..... *Cirsium lanceolatum* L.
 Fraiyōnah (Iraq)..... *Tulipa montana* Lindl.
 Fudanaj (Ar.)..... *Meniha sylvestris* L.
 Fūfal (Teh., Ar.)..... *Areca Catechu* L.
 Fulūs (Isf.)..... *Cassia Fistula* L.
 Fuluz mahi (Pers.)..... *Strychnos Nux-vomica* L.
 Funduk (Teh.)..... *Corylus Colurna* L.
 Fūtfūteh (Teh.)..... *Adansonia digitata* Juss.
 Fuwwah (Ar.)..... *Rubia Cordifolia* L. and *R. tinctorium* L.

 Gach-i-kāshān (Teh.)..... *Calcium Sulphate*
 Gaiwuzh (Turk.)..... *Crataegus orientalis* Bieb.

Gaizar (Iraq).....	<i>Daucus Carota</i> L.
Gajur (Hind.).....	<i>Daucus Carota</i> L.
Gandhak (Hind.).....	Sulphur
Gandum-âbî (Teh.).....	<i>Triticum vulgare</i> Vill.
Gandum-i-safid (Teh.).....	<i>Triticum vulgare</i> Vill.
Ganim (Kurd.).....	<i>Triticum</i> sp.
Gaoshira (Teh.).....	<i>Ferula galbaniflua</i> Boiss.
Garabi (Hind.).....	<i>Entada gigas</i> (L.) Fawc. & Rendle
Gara tsochorek oti (Tab.).....	<i>Nigella arvensis</i> L. (p. 144)
Gara za'arak (Tab.).....	<i>Lallemantia iberica</i> F. & M.
Garchak farangi (Teh.).....	<i>Ricinus communis</i> L.
Gashnish (Turk.).....	<i>Coriandrum sativum</i> L.
Gaz-alafi (Teh.).....	<i>Tamarix gallica</i> L. var. <i>mannifera</i> Ehrenb.
Gaz-anjabin (Teh.).....	<i>Tamarix gallica</i> L. var. <i>mannifera</i> Ehrenb. (also p. 162)
Gaz-i-khûnsâr (Teh.).....	<i>Tamarix gallica</i> L. var. <i>mannifera</i> Ehrenb.
Gaz-i-shakar.....	<i>Tamarix gallica</i> L. var. <i>mannifera</i> Ehrenb.
Gehun (Hind.).....	<i>Triticum vulgare</i> Vill.
Gentar.....	<i>Phoenix dactylifera</i> L.
Gharekum (Hind., Bom.).....	<i>Polyporus officinalis</i> Fries
Ghârigûn (Teh.).....	<i>Polyporus officinalis</i> Fries
Gharikun (Ind. bazaars).....	<i>Polyporus officinalis</i> Fries
Ghariquun (Gr.).....	See <i>Agaric</i>
Ghartsche (Schl.).....	<i>Agaric</i>
Ghaza gouzanah (Teh.).....	<i>Inula Helenium</i> L.
Ghich (Ham.).....	<i>Crataegus orientalis</i> Bieb.
Ghodaoumche chirazi (Schl.).....	<i>Alyssum campestre</i> L.
Ghya ke bij (Hind.).....	<i>Lagenaria vulgaris</i> Ser.
Giafari (Schl.).....	<i>Heracleum persicum</i> Desf.
Giash mashi (Ham.).....	<i>Quercus</i> sp.
Gidar tamaku (Hind.).....	<i>Verbascum Thapsus</i> L.
Gila (Beng.).....	<i>Entada gigas</i> (L.) Fawc. & Rendle
Gil-i-armanî (Pers., Hind.).....	Armenian Earth
Gil-i-batuni.....	Sigillated Earth
Gil-i-berz.....	Sigillated Earth
Gil-i-dâghistân (Isf., Teh.).....	Russian Clay
Gil-i-dschar (Achundow, Ph. Pers.).....	Calcium Sulphate
Gil-i-gazwin.....	Sigillated Earth
Gil-i-gubrasi.....	Cyprus Clay, Sigillated Earth
Gil-i-igritus.....	Cretan Earth, Sigillated Earth
Gil-i-khurasani.....	Edible Chalk, Sigillated Earth
Gil-i-makhdûm (Teh.).....	Sigillated Earth
Gil-i-misri.....	Egyptian Earth, Sigillated Earth
Gil-i-sarshûr (Teh., Afg.).....	Edible Clay
Gil-i-shamus.....	Samian Earth, Sigillated Earth
Gil-i-zard.....	Yellow Clay, Sigillated Earth
Gil-khwar (Laufer).....	See Armenian Earth
Gingelly (Hind.).....	<i>Sesamum indicum</i> L.
Girdû (Teh.).....	<i>Juglans regia</i> L.
Gizar Gia (Kurd.).....	<i>Hordeum</i> sp.
Glans Quercus Ballotae (Ph. Pers.).....	<i>Quercus persica</i> Jaub. & Spach
Godumai (Tam.).....	<i>Triticum vulgare</i> Vill.
Gogut (Yark.).....	Sulphur
Goi-zira (Tab.).....	<i>Cuminum Cyminum</i> L.
Gole himmicheh behar (Schl.).....	<i>Calendula officinalis</i> L.

Goleper (Kerm.)	<i>Heracleum persicum</i> Desf.
Gole zarde (Schl.)	<i>Rosa foetida</i> Herm.
Gol tighol (Royle)	<i>Echinops persicus</i> Stev.
Goondina (Pers.)	<i>Allium Cepa</i> L.
Gora vach (Hind.)	<i>Acorus Calamus</i> L.
Gorochan (Hind.)	<i>Capra aegagrus</i> Gmel.
Goulpere (Boiss.)	See <i>Heracleum persicum</i> Desf.
Govarikh (Bal.)	<i>Tulipa montana</i> Lindl.
Goz (Turk.)	<i>Juglans regia</i> L.
Gozharik (Kurd.)	<i>Citrullus Colocynthis</i> Schrad.
Granati Cortex (Ph. Pers.)	<i>Punica Granatum</i> L.
Guda (Hind.)	See <i>Saccharum officinarum</i> L.
Gudāmah (Teh.)	<i>Alyssum campestre</i> L.
Gudāmah-i-shahri (Teh.)	<i>Alyssum campestre</i> L.
Gudāmah-i-shērazi (Teh.)	<i>Alyssum campestre</i> L.
Guetcha (Schl.)	Calcium Sulphate
Gueza-elefi (Schl.)	<i>Quercus</i> sp. (p. 162)
Gueze elefi (Teh.)	<i>Quercus Vallonea</i> Kotschy
Guezmazedj (Teh.)	<i>Tamarix pentandra</i> Pall.
Gugal (Hind.)	<i>Commiphora Mukul</i> Engl.
Gügird-i-akhmar (Teh.)	Sulphur
Gügird-i-zard (Teh.)	Sulphur
Guize khounear (Schl.)	<i>Tamarix pentandra</i> Pall.
Gujar (Bom.)	<i>Astragalus fasciculæfolius</i> Boiss.
Gul gando (Bal.)	<i>Tagetes erecta</i> L.
Gul-i-abbasa (Pers.)	<i>Mirabilis Jalapa</i> L.
Gul-i-anār (Teh.)	<i>Punica Granatum</i> L.
Gul-i-arbore(?) (Teh.)	<i>Salvia Hydrangea</i> DC.
Gul-i-bābūna (Ham.)	<i>Anthemis Wiedemanniana</i> F. & M.
Gul-i-banafshah (Teh.)	<i>Viola</i> sp.
Gul-i-būmādarān	<i>Achillea Santolina</i> L.
Gul-i-chaman (Teh.)	<i>Lolium rigidum</i> Gaud.
Gul-i-gāv-zabān (Teh.)	<i>Echium amoenum</i> Fisch. & Mey. and other spp.
Gul-i-geshuz (Ham.)	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Gul-i-halvā (Isf.)	<i>Celosia argentea</i> L.
Gul-i-hamaz (Dymock)	<i>Rumex vesicarius</i> L. (p. 167)
Gul-i-ja'fari (Teh.)	<i>Tagetes erecta</i> L.
Gul-i-jauz.	<i>Myristica fragrans</i> Houtt.
Gul-i-kadū (Teh., Ham.)	<i>Cucurbita Pepo</i> DC.
Gul-i-kajira (Ar.)	<i>Carthamus tinctorius</i> L.
Gul-i-kākanj	<i>Physalis Alkekengi</i> L.
Gul-i-keshus (Pers.)	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Gul-i-khatmī	<i>Althaea lavateraefolia</i> DC.
Gul-i-khatmī (Teh.)	<i>Althaea</i> sp.
Gul-i-khatmī (Ait.)	<i>Malva sylvestris</i> L. var. <i>mauritiana</i> Boiss.
Gul-i-livās (Ham., Teh.)	<i>Rheum Ribes</i> L.
Gul-i-nīlūfār (Teh.)	<i>Nymphaea alba</i> L.
Gul-i-panīrak (Teh.)	<i>Malva sylvestris</i> L. var. <i>mauritiana</i> Boiss.
Gul-i-parr (Isf.)	<i>Heracleum persicum</i> Desf.
Gul-i-pisteh (Bom.)	<i>Pistacia Khinjuk</i> Stocks.
Gul-i-pūnah (Isf.)	<i>Mentha sylvestris</i> L.
Gul-i-pūnah (Teh.)	<i>Hyssopus officinalis</i> L. var. <i>angustifolia</i> Boiss.
Gul-i-raman-zeba (Ait.)	<i>Rosa foetida</i> Herm.
Gul-i-rang (Teh.)	<i>Carthamus tinctorius</i> L.
Gul-i-sarnigūn (Teh.)	<i>Fritillaria imperialis</i> L.

- Gul-i-sarv (Teh.).....*Cupressus sempervirens* L.
 Gul-i-serwaj (Pers.).....*Hymenocrater elegans* Br. (p. 168)
 Gul-i-shirper (Pers.).....*Fritillaria imperialis* L.
 Gul-i-sipar (Teh.).....*Heracleum persicum* Desf.
 Gul-i-surkh (Teh.).....*Rosa damascena* Mill.
 Gul-i-zard (Teh.).....*Rosa foetida* Herm.
 Gul-jafari (Hind.).....*Tagetes erecta* L.
 Gulkhand.....See *Rosa damascena* Mill.
 Gul nare-farci (Schl.).....*Punica Granatum* L.
 Gulnār-i-farsī (Teh.).....*Punica Granatum* L.
 Gur (Leh.).....See *Saccharum officinarum* L.
 Gurfah (Teh.).....*Cinnamomum Cassia* Blume
 Guzk (Kurd.).....*Juglans regia* L.

 Habbat Halwah (Iraq).....*Peucedanum graveolens* Benth. & Hook.
 Habb-dilmaluk (Ait.).....*Croton Tiglium* L.
 Habb-el-khatāi.....*Croton Tiglium* L.
 Habb-el-nīl (Ham.).....*Ipomoea hederacea* Jacq.
 Habb-el-salatin (Ham.).....*Croton Tiglium* L.
 Habb-i-balsān (Isf.).....*Commiphora opobalsamum* Kunth
 Habbu'l ghār (Isf.).....*Pistacia Khinjuk* Stocks.
 Habbu'l-ma'lab (Teh.).....*Prunus Mahaleb* L.
 Hab-el-aas (Ar.).....*Myrtus communis* L.
 Hab-el-a'ra'r (Ind. bazaars).....*Juniperus excelsa* Bieb.
 Hab-el-balasana (Ar.).....*Commiphora opobalsamum* Kunth
 Hab-el-zalim (Ar.).....*Hibiscus cannabinus* L.
 Hab-es-souda (Ar., Egy., Iraq).....*Nigella sativa* Sibth.
 Hab-safarjal.....*Pyrus Cydonia* L.
 Habul-khazra (Teh.).....*Pistacia Khinjuk* Stocks.
 Hab-ul-mahaliba (Ar.).....*Prunus Mahaleb* L.
 Hab-us-sudan (Ar.).....*Cassia Absus* L.
 Hajarat el dib (Ar.).....*Withania somnifera* Dunal
 Hajarū'l-yahūd (Pers.).....*Cidaris* sp.
 Hajr-el-armeni (Ar.).....*Armenian Earth*
 Halawi (Iraq).....*Phoenix dactylifera* L.
 Haldi (Hind.).....*Curcuma domestica* Val. and *C. longa* Trim.
 Halīlah-i-kābuli (Teh., Isf.).....*Terminalia Chebula* Retz.
 Halīlah-i-siyāh (Teh., Isf.).....*Terminalia Chebula* Retz.
 Halīlah-i-zard (Teh., Isf.).....*Terminalia Chebula* Retz.
 Halim (Hind.).....*Lepidium sativum* L.
 Haliyyin (Teh.).....*Asparagus officinalis* L.
 Halu zhgarh (Kurd.).....*Prunus domestica* L. var. *Juliana*
 Hamam Komandji (Turk.).....*Malva sylvestris* L. var. *mauritanica* Boiss.
 Hamīshah bahār (Teh., Iraq).....*Calendula officinalis* L.
 Handhal (Kurd.).....*Citrullus Colocynthis* Schrad.
 Hanzal (Ar.).....*Citrullus Colocynthis* Schrad.
 Har (Hind.).....*Terminalia Chebula* Retz.
 Hara (Hind.).....*Terminalia Chebula* Retz.
 Harhār-kohī (Afg.).....*Juniperus excelsa* Bieb.
 Haritaki (Beng.).....*Terminalia Chebula* Retz.
 Haritala (Sans.).....*Arsenic Trisulphide*
 Harmal (Ar., Iraq).....*Peganum Harmala* L.
 Harmal rutbah (Ar., Iraq).....*Peganum Harmala* L.
 Hartal (Hind.).....*Arsenic Trisulphide*
 Hasach (Iraq).....*Tribulus terrestris* L.
 Hasawi.....*Phoenix dactylifera* L.

Hastah-i-ālbālū (Teh.)	<i>Prunus Cerasus</i> L.
Hastah-i-nāranj (Teh.)	<i>Citrus sinensis</i> (L.) Osbeck
Hastah-i-zard ālū (Pers.)	<i>Prunus Armeniaca</i> L.
Havah-i-chūbah (Teh.)	<i>Onosma echioides</i> L.
Hawuch (Turk.)	<i>Daucus Carota</i> L.
Hebbel asle (Schl.)	<i>Tamarix pentandra</i> Pall.
Hebbul-beneh (Ar.)	<i>Pistacia Khinjuk</i> Stocks.
Helenion (Gr.)	<i>Inula Helenium</i> L.
Hermodactyl (Gr.)	<i>Colchicum luteum</i> Baker and <i>C. speciosum</i> Stev.
Hil (Ar.)	<i>Amomum subulatum</i> Roxb.
Hil (Iraq)	<i>Elettaria Cardamomum</i> Maton.
Hil-i-qurāb (Teh., Isf.)	<i>Amomum subulatum</i> Roxb.
Hinna (Iraq)	<i>Lawsonia alba</i> Lam.
Hinnāy-i-barg (Teh.)	<i>Lawsonia alba</i> Lam.
Hintah	<i>Triticum</i> sp.
Hintah Khushnah	<i>Triticum durum</i> Desf. (p. 182)
Hintah Qandahārī	<i>Triticum vulgare</i> Vill.
Hintah walwal	<i>Triticum</i> sp.
Hira dukhi (Hind.)	<i>Dracaena Cinnabari</i> Balf.
Hirda (Bom.)	<i>Terminalia Chebula</i> Retz.
Hishwarg (Bal.)	<i>Delphinium Zalil</i> Ait. & Hemsl.
Hsiang fu (Chin.)	<i>Cyperus rotundus</i> L.
Hulbah (Iraq)	<i>Trigonella Foenum-graecum</i> L.
Hurtāmūn (Iraq)	<i>Lathyrus sativus</i> L.
Idhrah baidha (Ar.)	<i>Sorghum vulgare</i> Pers.
Ighir iggur (Ar.)	<i>Acorus Calamus</i> L.
Ignatia Amara	<i>Strychnos Ignatii</i> Berg.
Ikilīl (Teh.)	<i>Astragalus hamosus</i> L.
Ikilīl-ul-malik (Ar.)	<i>Astragalus hamosus</i> L.
Ikilīl-ul-mulk (Bom.)	<i>Astragalus hamosus</i> L.
Ilachi (Hind.)	<i>Elettaria Cardamomum</i> Maton.
Imm-harmal	<i>Punica Granatum</i> L.
'Inab (Iraq)	<i>Vitis vinifera</i> L.
Inab-ath-thalab (Teh.)	<i>Solanum nigrum</i> L.
Inab-ed-dib (Ar.)	<i>Solanum nigrum</i> L.
Indrajaou (Hind.)	<i>Holarrhena antidysenterica</i> Wall.
Indrazana (Hind.)	<i>Citrullus Colocynthis</i> Schrad.
Intubus (Lat.)	<i>Cichorium Intybus</i> L.
Irisha (Ind. bazaars)	<i>Iris spuria</i> Pall.
Isbaghol (Bal.)	<i>Plantago ciliata</i> Desf. (p. 155)
Isband (Bom.)	<i>Corchorus olitorius</i> L.
Isfedaj (Ar.)	Plumbi Carbonas
Isghand (Bal.)	<i>Zataria multiflora</i> Boiss.
Ish-hony	<i>Gossypium peruvianum</i> (p. 123)
Ishtar (Ind. bazaars)	See <i>Cymbopogon Schoenanthus</i> Spreng.
Iskhir (Ar.)	<i>Cymbopogon Schoenanthus</i> Spreng.
Ispaghul (Pers.)	<i>Plantago ovata</i> Forsk.
Isparak (Teh.)	<i>Delphinium Zalil</i> Ait. & Hemsl.
Isparza (Yark.)	See Chahār-tukmah
Isparzah (Teh.)	<i>Plantago ovata</i> Forsk.
Ispinākh (Iraq)	<i>Spinacia oleracea</i> L.
Issikuttuz (Turk.)	<i>Salvia Hydrangea</i> DC.
Izgun (Bal.)	<i>Zataria multiflora</i> Boiss.
Izkhir-i-jami (Ar.)	<i>Vetiveria zizanioides</i> Stapf (also p. 111)

Ja (Chin.)	<i>Thea sinensis</i> L.
Ja'ad (Iraq)	<i>Teucrium Polium</i> L.
Jaephal (Hind.)	<i>Myristica fragrans</i> Houtt.
Ja'fari (Iraq)	<i>Tagetes erecta</i> L.
Jamalgota (Punj.)	<i>Croton Tiglium</i> L.
Jangali-haladi (Hind.)	<i>Curcuma aromatica</i> Salisb.
Jāv (Sind)	<i>Hordeum vulgare</i> L.
Jata-masi (Sans., Hind.)	<i>Nardostachys Jatamansi</i> DC.
Jatt (Ar.)	<i>Medicago sativa</i> L.
Jau (Iraq)	<i>Hordeum vulgare</i> L.
Jauz-i-būyā (Teh., Ar.)	<i>Myristica fragrans</i> Houtt.
Jav (Hind.)	<i>Hordeum vulgare</i> L.
Jawz-i-rumi (Afg.)	<i>Juglans regia</i> L.
Jayanti (Beng.)	<i>Sesbania aculeata</i> Poir.
Jazar (Iraq)	<i>Daucus Carota</i> L.
Jazr-ul-bostani (Ar.)	<i>Daucus Carota</i> L.
Jequirity (Tupi, Brazil)	<i>Abrus precatorius</i> L.
Jift (Teh.)	<i>Pistacia integerrima</i> Stew.
Jiljil (Iraq)	<i>Hibiscus cannabinus</i> L.
Jinjili (Hind.)	<i>Sesamum indicum</i> L.
Jira (Beng., Bom.)	<i>Cuminum Cyminum</i> L.
Jira-shak (N.E.Pers.)	<i>Carum Bulbocastanum</i> Koch
Jōshan Shīrāzī (Teh.)	<i>Thymus Serpyllum</i> L. var. <i>Kotschyanus</i> Boiss.
Jouj macel (Ar.)	<i>Datura Stramonium</i> L.
Jowar (Hind.)	<i>Sorghum vulgare</i> Pers.
Jōyi safid (Iraq)	<i>Hordeum vulgare</i> L.
Jōyi siyāh (Iraq)	<i>Hordeum vulgare</i> L.
Joz (Turk.)	<i>Juglans regia</i> L.
Ju (Kurd.)	<i>Hordeum vulgare</i> L.
Juft (Teh.)	<i>Pistacia integerrima</i> Stew.
Juntiyana (Duk.)	<i>Gentiana lutea</i> L.
Jupha (Hind.)	<i>Hyssopus officinalis</i> L. var. <i>angustifolia</i> Boiss.
Jūtiyānā (Isf.)	<i>Gentiana lutea</i> L.
Kabābah-i-chīnī (Teh., Isf.)	<i>Piper Cubeba</i> L.
Kababāh-i-dahan kushadeh (Pers.)	<i>Zanthoxylum Rhetsa</i> DC.
Kabab-chini (Hind.)	<i>Piper Cubeba</i> L.
Kabar (Pers., Iraq)	<i>Capparis spinosa</i> L.
Kabiste talkh (Pers.)	<i>Citrullus Colocynthis</i> Schrad.
Kachola (Pers.)	See <i>Datura Stramonium</i> L.
Kachura (Hind.)	<i>Curcuma Zedoaria</i> Roxb. and <i>C. Zerumbet</i> Roxb.
Kadu (Hind.)	<i>Cucurbita Pepo</i> DC.
Kaf-i-daryā (Ar.)	<i>Sepia officinalis</i> L.
Kāfshah (Teh., Ham.)	<i>Carthamus tinctorius</i> L.
Kahkuti (Bal.)	<i>Zizyphora tenuior</i> L.
Kahu-khaskabija (Hind.)	<i>Lactuca sativa</i> L.
Kaik-vāsh (Isf.)	<i>Crataegus orientalis</i> Bieb.
Kakanj (Isf., Teh.)	<i>Physalis Alkekengi</i> L.
Kākīl-i-zard (Teh.)	<i>Nannorrhops Ritchieana</i> Wendl.
Kākūtī (Teh.)	<i>Zizyphora tenuior</i> L.
Kaladanah (Hind.)	<i>Ipomoea hederacea</i> Jacq.
Kala Drakh (Ind.)	<i>Vitis vinifera</i> L.
Kala jira (Hind.)	<i>Nigella sativa</i> Sibth.
Kalamb-ki-jar (Hind.)	<i>Jateorhiza Columba</i> Miers
Kala-zirah (Afg.)	<i>Carum Bulbocastanum</i> Koch

Kalpah (Bom.).....	<i>Cinnamomum Cassia</i> Blume
Kalpura (Bal.).....	<i>Teucrium Stocksianum</i> Boiss. (p. 178)
Kamal (Ind.).....	<i>Nymphaea</i> sp. (p. 144)
Kamela (Hind., Bom.).....	<i>Mallotus philippinensis</i> Muell. Arg.
Kam-parah (Punj., Yark.).....	See Chahār-tukhmah
Kandal (Afg.).....	<i>Dorema Ammoniacum</i> Don
Kangar (Isf., Teh.).....	<i>Cynara Scolymus</i> L.
Kangar-i-dahri (Isf., Teh.).....	<i>Cynara Scolymus</i> L.
Kanim (Kurd.).....	<i>Triticum vulgare</i> Vill.
Kanocha (Isf.).....	<i>Salvia macrosiphon</i> Boiss.
Kansburaj (Ind. bazaars).....	<i>Adiantum Capillus-Veneris</i> L.
Kapila (Mad.).....	<i>Mallotus philippinensis</i> Muell. Arg.
Karafs (Iraq).....	<i>Apium graveolens</i> L.
Karanaphal (Ar.).....	<i>Eugenia aromatica</i> Baill.
Karaza (Hind.).....	<i>Prunus Cerasus</i> L.
Karawyah (Iraq).....	See <i>Peucedanum graveolens</i> Benth. & Hook.
Karaz (Ar.).....	<i>Prunus Cerasus</i> L.
Karbasu (Achundow).....	See <i>Rocella Montagnei</i> Bél.
Karchak (Ham.).....	<i>Ricinus communis</i> L.
Karedemonah (Ham.).....	<i>Conium maculatum</i> L.
Karezgi (Bal.).....	<i>Solanum nigrum</i> L.
Karkooti.....	Egyptian Earth, Sigillated Earth
Karkum (Pers.).....	<i>Crocus sativus</i> L.
Karkum (Teh.).....	<i>Curcuma domestica</i> Val. and <i>C. longa</i> Trim.
Karni YariKh (Tab.).....	<i>Plantago</i> sp.
Kār shūtūr (Pers.).....	<i>Alhagi camelorum</i> Fisch.
Karūt (Afg.).....	<i>Bos indicus</i>
Karvaya-i-dashti (Pers.).....	<i>Conium maculatum</i> L.
Kashburat (Teh.).....	<i>Adiantum Capillus-Veneris</i> L.
Kashburat-el-bir (Pers.).....	<i>Adiantum Capillus-Veneris</i> L.
Kashi (Hind., Bom., Beng.).....	<i>Cichorium Intybus</i> L.
Kashi (Leh.).....	See <i>Saccharum officinarum</i> L.
Kashir (Bal.).....	<i>Erysimum repandum</i> L.
Kashk Kashk (Kurd.).....	<i>Bos indicus</i>
Kashus (Pers.).....	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Kashūth (Ar.).....	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Kasis (Pers.).....	<i>Lepidium Iberis</i> L. (p. 171)
Kassutha (Gr.).....	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Katan (Ait., Afg.).....	<i>Linum usitatissimum</i> L.
Katek bah(?) (Teh.).....	<i>Pyrethrum</i> sp.(?)
Kathirā (Teh.).....	<i>Astragalus gummifer</i> Labill.
Kāt-i-gulābi (Teh.).....	<i>Uncaria Gambier</i> Roxb.
Katira gond (Hind.).....	<i>Astragalus gummifer</i> Labill.
Kat karanj (Hind.).....	<i>Caesalpinia Bonducella</i> Roxb.
Katun (Ait., Afg.).....	<i>Linum usitatissimum</i> L.
Kavl-a-kūknār (Pers., Afg.).....	<i>Papaver somniferum</i> L.
Kawich (Isf.).....	<i>Crataegus orientalis</i> Bieb.
Keruwiah (Isf.).....	<i>Chaerophyllum</i> sp.
Kesa.....	<i>Quercus</i> sp.
Kesar (Kash.).....	<i>Crocus sativus</i> L.
Kesara (Hind.).....	<i>Crocus sativus</i> L.
Kesari (Hind.).....	<i>Lathyrus sativus</i> L.
Keshus (Pers.).....	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Khabazi (Ar.).....	<i>Malva sylvestris</i> L. var. <i>mauritiana</i> Boiss.
Khadrawi (Iraq).....	<i>Phoenix dactylifera</i> L.
Khakechi (Schl.).....	<i>Erysimum repandum</i> L.

Khāk-i-mugl (Teh.).....	<i>Commiphora Molmol</i> Engl.
Khākshir (Teh.).....	<i>Sisymbrium Sophia</i> L. (also p. 118)
Khākshir-i-shīrīn (Teh.).....	<i>Sisymbrium Sophia</i> L.
Khakshir-talkh (Isf.).....	<i>Erysimum repandum</i> L.
Khaksi (Hind.).....	<i>Sisymbrium Sophia</i> L.
Khalal.....	<i>Phoenix dactylifera</i> L.
Khalal-i-nāranj (Teh.).....	<i>Citrus sinensis</i> (L.) Osbeck
Khand (Leh).....	See <i>Saccharum officinarum</i> L.
Kharbuz (Ind. bazaars).....	See <i>Citrullus vulgaris</i> Schrad.
Kharbūzah-rūbāh (Pers.).....	<i>Citrullus Colocynthis</i> Schrad.
Khardal.....	<i>Brassica nigra</i> (L.) Koch
Khardal-i-shahrī (Teh., Ham.).....	<i>Salvia</i> sp.
Khar-danick (Bal.).....	<i>Plantago ovata</i> Forsk.
Khār-khasak (Teh.).....	<i>Tribulus terrestris</i> L.
Khar mahra (Pers.).....	<i>Cypraea moneta</i> L.
Kharnūbān (Isf.).....	<i>Prosopis Stephaniana</i> Kunth
Khar-shnai (Kash.).....	<i>Pistacia integerrima</i> Stew.
Khas Khas (Hind.).....	<i>Vetiveria zizanioides</i> Stapf
Khasib.....	<i>Phoenix dactylifera</i> L.
Khatmi.....	See <i>Malva sylvestris</i> L. var. <i>mauritiana</i> Boiss.
Khatmolt (Bal.).....	See Mummy
Khavi (Hind.).....	<i>Cymbopogon Schoenanthus</i> Spreng.
Khaza-i-iblis.....	<i>Caesalpinia Bonducella</i> Roxb.
Khib-baze (Schl.).....	<i>Malva sylvestris</i> L. var. <i>mauritiana</i> Boiss.
Khili-wili (Tab.).....	<i>Lepidium Draba</i> L.
Khira (Punj.).....	<i>Cucumis sativus</i> L.
Khitmi.....	See <i>Malva sylvestris</i> L. var. <i>mauritiana</i> Boiss.
Khitmi-i-kuchak (Pers.).....	<i>Malva sylvestris</i> L. var. <i>mauritiana</i> Boiss.
Khorasain-ajwan (Ind. bazaars).....	<i>Conium maculatum</i> L.
Khove (Afg.).....	<i>Nannorrhops Ritchieana</i> Wendl.
Khū (Afg.).....	<i>Nannorrhops Ritchieana</i> Wendl.
Khubah (Ar.).....	<i>Erysimum repandum</i> L.
Khūbani (Hind.).....	<i>Prunus Armeniaca</i> L.
Khub-kalan (Hind.).....	<i>Sisymbrium Sophia</i> L.
Khūlanjān (Teh.).....	<i>Langas officinarum</i> Burkill
Khūn-i-siyāvash (Isf.).....	<i>Dracaena Cinnabari</i> Balf.
Khurmā.....	<i>Phoenix dactylifera</i> L.
Khushak (Ham.).....	<i>Asparagus adscendens</i> Roxb.
Khushk-horāk (Afg.).....	<i>Bos indicus</i>
Kinguere (Schl.).....	<i>Cynara Scolymus</i> L.
Kira (Hind.).....	<i>Cucumis sativus</i> L.
Kirmanī (Isf.).....	<i>Carum Bulbocastanum</i> Koch
Kisa.....	<i>Quercus</i> sp.
Kishah-i-kasni (Ham., Teh.).....	<i>Cichorium Intybus</i> L.
Kisher Kundur.....	<i>Boswellia Carterii</i> Bird.
Kish-kash (Ar.).....	<i>Papaver somniferum</i> L.
Kishmish (Pers.).....	<i>Vitis vinifera</i> L.
Kishmish-askari (Bagh.).....	<i>Vitis vinifera</i> L.
Kishmish-i-dūgh (Bagh.).....	<i>Vitis vinifera</i> L.
Kishmish-i-kūli (Teh.).....	<i>Loranthus Grewinkii</i> Boiss. & Bunge
Kishmish-i-sabzah (Bagh.).....	<i>Vitis vinifera</i> L.
Kishmish-kawali (Ind. bazaars).....	<i>Loranthus Grewinkii</i> Boiss. & Bunge
Kisht bar Kisht (Pers.).....	<i>Helicteres Isora</i> L.
Kodu (Ind. bazaars).....	See <i>Citrullus vulgaris</i> Schrad.

Kohi bang (Bal.).....	<i>Hyoscyamus reticulatus</i> L.
Kohl Farsi (Pers.).....	<i>Astragalus fasciculaefolius</i> Boiss.
Kohl Kirmani.....	<i>Astragalus fasciculaefolius</i> Boiss.
Kondochi (Schl.).....	<i>Veratrum album</i> L.
Koriyan (Gr.).....	<i>Coriandrum sativum</i> L.
Kornub (Isf.).....	<i>Prosopis Stephaniana</i> Kunth
Kors-i-kamar (Ait.).....	<i>Entada gigas</i> (L.) Fawc. & Rendle
Koshataki (Sans.).....	<i>Luffa acutangula</i> Roxb.
Krafas-al-bir (Iraq).....	<i>Adiantum Capillus-Veneris</i> L.
Kriwarik (Turk.).....	Agaric
Krüt (Afg.).....	<i>Bos indicus</i>
Kuchila (Hind.).....	<i>Strychnos Nux Vomica</i> L.
Kuchūlah (Teh.).....	<i>Strychnos Nux Vomica</i> L.
Kūhān-i-shutur (Teh.).....	<i>Camelus dromedarius</i> L.
Kuhl (Pers.).....	<i>Antimonium Sulphidum</i>
Kukil-i-pol (Kash.).....	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Kulambū (Teh.).....	<i>Jateorhiza Columba</i> Miers
Kunbut (Syr.).....	<i>Prosopis Stephaniana</i> Kunth
Kundij (Turk.).....	<i>Sesamum indicum</i> L.
Kundur (Achundow).....	<i>Gypsophila paniculata</i> L.
Kundur (Teh.).....	<i>Boswellia Carterii</i> Bird.
Kundura unsa and zakara.....	<i>Boswellia Carterii</i> Bird.
Kundusch (Achundow).....	<i>Gypsophila paniculata</i> L.
Kundush (Ham., Teh.).....	<i>Veratrum album</i> L.
Kunjad (Bom.).....	<i>Astragalus fasciculaefolius</i> Boiss.
Kunjad (Kurd.).....	<i>Sesamum indicum</i> L.
Kunjada (Ait.).....	<i>Astragalus fasciculaefolius</i> Boiss.
Kunjidāh-i-surkh u safid (Teh.).....	<i>Astragalus fasciculaefolius</i> Boiss.
Kurdumana (Hind.).....	<i>Conium maculatum</i> L.
Kurk amla (Turk.).....	<i>Phyllanthus Emblica</i> L.
Kurwa (Ar., Iraq).....	<i>Ricinus communis</i> L.
Kusam (Hind.).....	<i>Carthamus tinctorius</i> L.
Kusa misri (Leh.).....	See <i>Saccharum officinarum</i> L.
Kust (Ham.).....	<i>Saussurea Lappa</i> C. B. Clarke
Kutha Kushṭa patchuk (Hind.).....	<i>Saussurea Lappa</i> C. B. Clarke
Kuzbara (Ar., Iraq).....	<i>Coriandrum sativum</i> L.
Lachyat-as-sheikh.....	See <i>Lecanora esculenta</i> Eversm.
Lakh (Bom.).....	<i>Lathyrus sativus</i> L.
Lāla (Afg.).....	<i>Tulipa montana</i> Lindl.
Lal-chandan (Hind.).....	<i>Pterocarpus santalinus</i> L.
Lal mirch (Hind.).....	<i>Capsicum frutescens</i> L.
Lang (Guz.).....	<i>Lathyrus sativus</i> L.
Lapis jadaicus (Ph. Pers.).....	<i>Cidaris</i> sp.
Lār (Kash.).....	<i>Cucumis sativus</i> L.
Lāsūrkḥ (Teh., Isf.).....	<i>Cupri oxidum</i>
Laung (Hind.).....	<i>Eugenia aromatica</i> Baill.
Leeka (Iraq).....	<i>Rhodymenia</i> sp.
Lehsan (Hind.).....	<i>Allium sativum</i> L.
Lek-poshte (Schl.).....	<i>Testudo horsfieldii</i> Grey and <i>T. graeca</i>
Lesan ul Lamal (Ar.).....	<i>Plantago ovata</i> Forsk.
Liane vermifuge (Fr.).....	<i>Quisqualis indica</i> L.
Lihayat as-shāyib (Bagh.).....	<i>Roccella Montagnei</i> Bél.
Lihayat as-shāyib (Iraq).....	<i>Cladophora</i> sp. (p. 165)
Lihur.....	<i>Phoenix dactylifera</i> L.
Limmon Basra (Iraq).....	<i>Citrus aurantifolia</i> (Christm.) Swingle

Limon (Iraq).....	<i>Citrus aurantifolia</i> (Christm.) Swingle
Limon-amman (Iraq).....	<i>Citrus aurantifolia</i> (Christm.) Swingle
Livās (Pers., Ar.).....	<i>Rheum Ribes</i> L.
Lizan ul usafr (Achundow).....	<i>Holarrhena antidysenterica</i> Wall.
Lubia (Iraq).....	<i>Vigna Catjang</i> Walp.
Lubia (Teh.).....	<i>Phaseolus vulgaris</i> L.
Lubia-kermiz (Teh.).....	<i>Phaseolus vulgaris</i> L.
Lūbiyā-gul (Teh.).....	<i>Dolichos Lablab</i> L.
Lukah (Kurd.).....	<i>Gossypium</i> sp. (p. 123)
Lyka (Iraq).....	<i>Rhodymenia</i> sp.
Mab-ul-dan (Ar.).....	<i>Melia Azedarach</i> L.
Maghdunes (Iraq).....	<i>Carum Petroselinum</i> Benth. & Hook.
Maglah.....	<i>Matricaria</i> sp.
Mahizahraj (Ar.).....	<i>Verbascum Thapsus</i> L.
Māhriz (Kash.).....	See <i>Lecanora esculenta</i> Eversm.
Maiphala (Hind.).....	<i>Quercus infectoria</i> Olivier
Majandri (Bal.).....	<i>Sesbania aculeata</i> Poir.
Mak (Bal.).....	<i>Vigna Catjang</i> Walp.
Māmīrān (Teh.).....	<i>Coptis Teeta</i> Wall.
Māmīz (Teh.).....	<i>Capra</i> sp.
Māmīz-i-kirī (Teh.).....	<i>Capra</i> sp.
Manjit (Hind.).....	<i>Rubia Cordifolia</i> L. and <i>R. tinctorium</i>
Mānsarīl (Kash.).....	<i>Polygonum amplexicaule</i> Don (p. 156)
Mārchūbah (Ham.).....	<i>Asparagus adscendens</i> Roxb.
Mārdan gusht.....	<i>Stachys lavandulaefolia</i> Vahl
Marg-i-māhī (Teh.).....	<i>Anamirta paniculata</i> Coleb.
Marjanjūsh (Achundow).....	<i>Origanum Majorana</i> L. (p. 174)
Mārmūt (Ait.).....	<i>Boucerosca Aucheri</i> (?) (p. 135)
Marorphali (Hind.).....	<i>Helicteres Isora</i> L.
Marv (Isf.).....	<i>Salvia macrosiphon</i> Boiss.
Marva (Yark.).....	See Chahār-tukhmah
Maryam nukhūdi (Teh.).....	<i>Teucrium Polium</i> L.
Marzanjūsh (Tab.).....	<i>Stachys lavandulaefolia</i> Vahl
Marzanpish (Teh.).....	<i>Zataria multiflora</i> Boiss.
Māsh (Iraq, Pers.).....	<i>Phaseolus radiatus</i> L.
Masha (Sans.).....	<i>Phaseolus radiatus</i> L.
Mashana churro (Bal.).....	Mummy
Mash-i-maha (Afg.).....	<i>Phaseolus radiatus</i> L.
Masūr (Hind.).....	<i>Lens esculenta</i> Moench
Maur (Bal.).....	<i>Salvia aegyptica</i> L. (p. 169)
Māyah-i-barrāh (Isf.).....	<i>Ovis</i> sp.
Māzaryūn (Teh.).....	<i>Verbascum Thapsus</i> L.
Māzū (Isf.).....	<i>Quercus infectoria</i> Olivier
Meriam Nekhodi (Teh.).....	<i>Teucrium scordioides</i> Schreb. (p. 177)
Mētahk (Iraq).....	<i>Juglans regia</i> L.
Methi (Hind., Bom.).....	<i>Trigonella Foenum-graecum</i> L.
Mishi.....	<i>Phoenix dactylifera</i> L.
Mishk-i-taramashia (Ind. bazaars).....	<i>Zizyphora tenuior</i> L.
Mishmish (Iraq).....	<i>Prunus Armeniaca</i> L.
Misri (Egy.).....	See <i>Saccharum officinarum</i> L.
Mivah-i-zabān-i-gunjishk (Pers.).....	<i>Holarrhena antidysenterica</i> Wall.
Moghl-ezregh (Schl.).....	<i>Commiphora Mukul</i> Engl.
Moma (Hind.).....	<i>Hymenoptera, Apoidea</i>

Moohar-khas (Ind. bazaars).....	<i>Adiantum Capillus-Veneris</i> L.
Motha (Hind.).....	<i>Cyperus rotundus</i> L.
Muchchah (Isf.).....	<i>Lepidium Draba</i> L.
Mughat (Egy.).....	<i>Glossostemon Bruguieri</i> Desf.
Mugrila (Hind.).....	<i>Nigella sativa</i> Sibth.
Mukhlisah.....	<i>Matricaria</i> sp.
Mukul, See muql	
Mula (Hind.).....	<i>Raphanus sativus</i> L.
Mulukhiyah (Iraq).....	<i>Corchorus olitorius</i> L.
Mūm (Teh.).....	<i>Hymenoptera</i> , Apoidea
Mūm-i-kāfūrī.....	<i>Hymenoptera</i> , Apoidea
Mūmiyā (Pers.).....	Mummy
Mūmiyāi (Pers.).....	Mummy
Munakha (Pers.).....	<i>Vitis vinifera</i> L.
Mun-e-makki (Teh.).....	<i>Commiphora Molmol</i> Engl.
Muql (Ar.).....	See <i>Commiphora Mukul</i> Engl.
Muql-i-abair (Teh.).....	<i>Commiphora Mukul</i> Engl.
Muql-i-azrāq (Teh.).....	<i>Commiphora Mukul</i> Engl.
Muql-i-yahud (Teh.).....	<i>Commiphora Mukul</i> Engl.
Mur (Hind., Bom.).....	<i>Commiphora Molmol</i> Engl.
Murda sang (Teh.).....	Plumbi Oxidum
Murdā sang-i-nugra'i (Teh.).....	Plumbi Oxidum
Murdā sang-i-tilā'i (Teh.).....	Plumbi Oxidum
Murd-i-sabz.....	<i>Myrtus communis</i> L.
Muro (Hind.).....	<i>Raphanus sativus</i> L.
Musabbar (Ar.).....	<i>Aloe Perryi</i> Baker
Muschk-i-zemin.....	<i>Cyperus rotundus</i> L.
Myrrha mechenensis (Ph. Pers.).....	<i>Commiphora Molmol</i> Engl.
Nafal (Iraq).....	<i>Trifolium repens</i> L.
Nafil (Iraq).....	<i>Trifolium repens</i> L.
Nakhl.....	<i>Phoenix dactylifera</i> L.
Nakhūd (Teh., Punj., Turk.).....	<i>Cicer arietinum</i> L.
Namak (Teh.).....	Sodium carbonate
Naphae flores (Schl.).....	<i>Citrus sinensis</i> (L.) Osbeck
Nar (Turk.).....	<i>Punica Granatum</i> L.
Nasābīdah-i-kirmanī (Teh.).....	<i>Indigofera tinctoria</i> L.
Nashwar (Pers.).....	<i>Nicotiana</i> sp.
Nenuphar (Ph. Pers.).....	<i>Nymphaea alba</i> L.
Nil (Hind.).....	<i>Indigofera tinctoria</i> L.
Nil-kanthe (Punj.).....	<i>Chrozophora verbascifolia</i> Juss.
Nilūfar.....	See <i>Nymphaea alba</i> L.
Nilūfar-i-kirmānashāhi (Teh.).....	<i>Nymphaea alba</i> L.
Nishāstah (Teh.).....	<i>Triticum vulgare</i> Vill.
Nisik (Kurd. in Iraq).....	<i>Lens esculenta</i> Moench
Nok (Kurd.).....	<i>Cicer arietinum</i> L.
Normush (Ham.).....	<i>Ochrocarpus longifolius</i> Benth. & Hook.
Nukhūd-i-alvand (Teh., Isf.).....	<i>Aristolochia rotunda</i> L.
Nukhund-i-alavandi (Ar.).....	<i>Aristolochia rotunda</i> L.
Numi Basra.....	<i>Citrus aurantifolia</i> (Christm.) Swingle
Nūr-mūs (Ham.).....	<i>Ochrocarpus longifolius</i> Benth. & Hook.
Omum (Tam.).....	<i>Carum copiticum</i> Benth. & Hook.
Orisa (Afg.).....	<i>Iris spuria</i> Pall.
Osteocolla (Lat.).....	Mummy
Osthokhodouce (Schl.).....	<i>Lavandula dentata</i> L.

Pachman-i-puh (Teh.)	<i>Helicteres Isora</i> L.
Pādzahr (Pers.)	<i>Capra aegagrus</i> Gmel.
Paglah (Kurd.)	<i>Vicia Faba</i> L.
Paiwand-e-maryam (Pers.)	<i>Prunus Mahaleb</i> L.
Pāla-mangy (Kash.)	See <i>Lecanora esculenta</i> Eversm.
Palas Keby (Hind.)	<i>Butea frondosa</i> Roxb.
Palaspapado (Duk.)	<i>Butea frondosa</i> Roxb.
Palsan (Hind.)	<i>Hibiscus cannabinus</i> L.
Pambu (Kurd.)	<i>Gossypium</i> sp. (p. 123)
Pambuq (Turk.)	<i>Gossypium</i> sp. (p. 123)
Panirak	See <i>Malva sylvestris</i> L. var. <i>mauritiana</i> Boiss.
Panir māyeh	<i>Ovis</i> sp.
Papal (Pers.)	<i>Areca Catechu</i> L.
Papita (Ar., Hind., Bom.)	<i>Strychnos Ignatii</i> Berg.
Pāptiyāl (Teh.)	<i>Strychnos Ignatii</i> Berg.
Parakeh-i-hindī (Teh.)	<i>Butea frondosa</i> Roxb.
Parr-i-siyāvash	<i>Adiantum Capillus-Veneris</i> L.
Pat (Beng.)	<i>Bombyx fortunatus</i> Hutton
Patchak (Beng.)	<i>Saussurea Lappa</i> C. B. Clarke
Pathar-ka-ber (Hind.)	<i>Cidaris</i> sp.
Pating (Afg.)	<i>Prunus Armeniaca</i> L.
Pechak (Hind.)	<i>Helicteres Isora</i> L.
Peganon (Scripture)	<i>Ruta graveolens</i> L.
Penirek (Schl.)	<i>Malva sylvestris</i> L. var. <i>mauritiana</i> Boiss.
Phataki (Hind.)	Alum
Phitkari (Hind.)	Alum
Piaz (Kurd.)	<i>Allium Cepa</i> L.
Pilah abrisham (Teh.)	<i>Bombyx fortunatus</i> Hutton
Pileh	<i>Bombyx fortunatus</i> Hutton
Pil gush	<i>Inula Helenium</i> L.
Pinang (Mal.)	<i>Areca Catechu</i> L.
Pirinj (Turk.)	<i>Oryza sativa</i> L.
Pistah (Teh.)	<i>Pistacia vera</i> L.
Pitar saleri (Hind.)	<i>Carum Petroselinum</i> Benth. & Hook.
Pōst-a-kūknār (Pers., Afg.)	<i>Papaver somniferum</i> L.
Post-i-limon (Afg.)	<i>Citrus aurantiifolia</i> (Christm.) Swingle
Post-i-nāranj	<i>Citrus sinensis</i> (L.) Osbeck
Prabala (Sans.)	<i>Corallium rubrum</i> Lam.
Psylli semina (Ph. Pers.)	<i>Plantago ovata</i> Forsk.
Pudina (Hind., Pers.)	<i>Mentha sylvestris</i> L.
Pūnah (Teh.)	<i>Mentha sylvestris</i> L.
Pune (Teh.)	<i>Quercus Vallonea</i> Kotschy
Punir-mayeh-shutur (Pers.)	<i>Camelus dromedarius</i> L.
Punjah-i-salaba	<i>Orchis latifolia</i> L.
Pūst-i-kinah-kinah (Teh.)	<i>Cinchona Calisaya</i> Wedd.
Pust-i-pistah (Teh.)	<i>Pistacia vera</i> L.
Pust-i-utruj (Teh.)	<i>Citrus sinensis</i> (L.) Osbeck
Qalyāb (Teh.)	Sodium Carbonate
Qamr-ad-din	<i>Prunus Armeniaca</i> L.
Qanaqinah (Iraq)	<i>Cinchona Calisaya</i> Wedd.
Qantaryūn (Teh.)	<i>Equisetum ramosissimum</i> Desf.
Qarah Koz (Turk.)	<i>Calendula officinalis</i> L.
Qaranful (Iraq)	<i>Eugenia aromatica</i> Baill.
Qaranful-asward (Iraq)	<i>Eugenia aromatica</i> Baill.
Qārch (Teh.)	Agaric

Qar-i-qurūt (Teh.).....	<i>Bos indicus</i>
Qarpuz (Turk.).....	<i>Citrullus vulgaris</i> Schrad.
Qatera (Hind.).....	<i>Astragalus gummifer</i> Labill.
Qatt (Ar.).....	<i>Medicago sativa</i> L.
Qodumah (Ar.).....	<i>Alyssum campestre</i> L.
Qunah baqan (Turk.).....	<i>Helianthus annuus</i> L.
Qunbalilah (Teh.).....	<i>Mallotus philippinensis</i> Muell. Arg.
Qunnab.....	<i>Hibiscus cannabinus</i> L. (p. 125)
Qurdumānā (Teh.).....	<i>Chaerophyllum</i> sp.
Qurs-i-kamar (Teh.).....	<i>Entada gigas</i> (L.) Fawc. & Rendle
Qurtum (Ar.).....	<i>Carihamus tinctorius</i> L.
Qurunbād (Teh.).....	<i>Curcuma aromatica</i> Salisb.
Qurūt (Teh.).....	<i>Bos indicus</i>
Qust-i-talkh (Teh.).....	<i>Saussurea Lappa</i> C. B. Clarke
Qutn (Ar.).....	<i>Gossypium</i> sp.
Qutn Amerikani.....	<i>Gossypium hirsutum</i> L. (p. 122)
Qutn Iraqi.....	<i>Gossypium herbaceum</i> L. (p. 122)
Qutn Misri.....	<i>Gossypium</i> sp. (p. 123)
Rad. Junci odorati (Ph. Pers.)....	<i>Cyperus rotundus</i> L.
Rahishi (Ar.).....	<i>Sesamum indicum</i> L.
Raihan (Ar.).....	<i>Ocimum Basilicum</i> L.
Raihan (Yark.).....	See Chahār-tukhmah
Raiz de China (Port.).....	<i>Smilax China</i> L. and <i>S. glabra</i> Roxb.
Rajajira (Bom.).....	<i>Corchorus olitorius</i> L.
Rakta Chandana (Sans.).....	<i>Pterocarpus santalinus</i> L.
Rangan-ki-bel (Hind.).....	<i>Quisqualis indica</i> L.
Rangh (Ar., Hind.).....	<i>Lawsonia alba</i> Lam.
Rang-i-kirmānī (Teh.).....	<i>Indigofera tinctoria</i> L.
Rang-i-sābidah (Teh.).....	<i>Indigofera tinctoria</i> L.
Rang-i-vasmah (Teh.).....	<i>Indigofera tinctoria</i> L.
Rang-mehndi (Hind.).....	<i>Lawsonia alba</i> Lam.
Ranj-i-badshah.....	<i>Onosma</i> sp.
Rasan.....	<i>Inula Helenium</i> L.
Rashi (Bagh.).....	<i>Sesamum indicum</i> L.
Ra's-i-hindi (Teh.).....	<i>Inula Helenium</i> L.
Rasin (Hind.).....	<i>Sesbania aculeata</i> Poir.
Rasna (Hind.).....	<i>Inula Helenium</i> L.
Ratanjali (Guz.).....	<i>Pterocarpus santalinus</i> L.
Ratanjot (Hind.).....	<i>Onosma echiodides</i> L.
Rati (Hind.).....	<i>Abrus precatorius</i> L.
Rātiyanah (Teh.).....	<i>Pterocarpus santalinus</i> L.
Razmah (Kash.).....	<i>Phaseolus vulgaris</i> L.
Resha-i-kishvar (Ham., Isf., Teh.)..	<i>Cuscuta planifolia</i> Ten. and <i>C. hyalina</i> Roth
Resham.....	<i>Bombyx fortunatus</i> Hutton
Resham-ki-keri (Duk.).....	<i>Bombyx fortunatus</i> Hutton
Reyhane Kouhi (Schl.).....	<i>Ocimum canum</i> Sims
Risha Baba Adam (Schl.).....	<i>Arctium Lappa</i> L.
Rīshah havah-i-chūbah (Ham.)....	<i>Onosma echiodides</i> L.
Rīshah-i-anār (Teh.).....	<i>Punica Granatum</i> L.
Rīshah-i-anjabār (Teh.).....	<i>Polygonum Bistorta</i> L.
Rīshah-i-arisa (Teh.).....	<i>Iris spuria</i> Pall.
Rīshah-i-asl-i-sūs (Teh.).....	<i>Glycyrrhiza glabra</i> L.
Rīshah-i-bābā-Adam (Teh.).....	<i>Arctium Lappa</i> L.
Rīshah-i-kabar (Teh.).....	<i>Capparis spinosa</i> L.
Rīshah-i-kalafs (Teh.).....	<i>Ferula Sumbul</i> Hook. f.

Rishah-i-khatmi (Ham.).....	<i>Althaea lavateraefolia</i> DC.
Rishah-i-rāziyānah (Teh.).....	<i>Foeniculum vulgare</i> Mill.
Rishah-shāh-tūt (Teh.).....	<i>Morus nigra</i> L.
Rishah tamesh (Teh.).....	<i>Plumbago rosea</i> L.
Rish-shar (Teh.).....	<i>Ferula galbaniflua</i> Boiss.
Rivand-i-chini (Isf., Teh.).....	<i>Rheum palmatum</i> L.
Riwas (Punj.).....	<i>Rheum Ribes</i> L.
Roghan-i-khash khāsh.....	<i>Papaver somniferum</i> L.
Roghan-i-zagher (Ait., Afg.).....	<i>Linum usitatissimum</i> L.
Rojia (Port.).....	<i>Tagetes erecta</i> L.
Rounace (Schl.).....	<i>Rubia Cordifolia</i> L. and <i>R. tinctorium</i> L.
Rubb-i-sūs.....	<i>Glycyrrhiza glabra</i> L.
Rughan-i-char-i-chesak.....	See <i>Tribulus terrestris</i> L.
Ruhan (Kurd.).....	<i>Ocimum Basilicum</i> L.
Rūnās (Teh., Isf.).....	<i>Rubia Cordifolia</i> L. and <i>R. tinctorium</i> L.
Rūniyās (Teh., Isf.).....	<i>Rubia Cordifolia</i> L. and <i>R. tinctorium</i> L.
Rutab.....	<i>Phoenix dactylifera</i> L.
Ruzz (Ar.).....	<i>Oryza sativa</i> L.
Sa'ad (Iraq).....	<i>Cyperus rotundus</i> L.
Sa'atar (Ind. bazaars).....	<i>Zataria multiflora</i> Boiss.
Sabr-i-zard (Teh.).....	<i>Aloe Perryi</i> Baker
Sadaf (Ar.).....	<i>Cypraea moneta</i> L.
Sādhaj-i-hindi (Isf.).....	<i>Cinnamomum Cassia</i> Blume
Safid āb-i-shaikh (Teh.).....	Plumbi Carbonas
Sag-anjar.....	<i>Solanum Dulcamara</i> L. (p. 172)
Sages (Staff.).....	<i>Pistacia Terebinthus</i> L.
Sagiz-i-safid (Teh.).....	<i>Pistacia Terebinthus</i> L.
Sag Palak (Hind.).....	<i>Spinacia oleracea</i> L.
Sa'ir.....	<i>Phoenix dactylifera</i> L.
Saisaban (Egy.).....	<i>Sesbania aculeata</i> Poir.
Sajji mati.....	Sodium Carbonate
Saka-binaja (Ar.).....	<i>Ferula persica</i> Willd.
Sakbīnaj (Teh.).....	<i>Ferula persica</i> Willd.
Sakulali (Teh.).....	<i>Commiphora Mukul</i> Engl.
Sa'lab (Teh.).....	<i>Orchis latifolia</i> L.
Salab-misri (Ar.).....	<i>Orchis latifolia</i> L.
Samagh Hamama (Hind.).....	<i>Dorema Ammoniacum</i> Don
Samgh Arabi (Ar., Pers.).....	<i>Acacia Senegal</i> Willd.
Samgh-i-arzhan (Teh.).....	<i>Acacia Senegal</i> Willd.
Samgh nadh (Punj.).....	<i>Nummulites</i> sp.
Samudraphena (Sans.).....	<i>Sepia officinalis</i> L.
Sanā (Teh.).....	<i>Cassia acutifolia</i> Delile
Sana-hindi (Ar.).....	<i>Cassia acutifolia</i> Delile
Sana-mukhi (Iraq).....	<i>Cassia acutifolia</i> Delile
Sandal-i-safid (Teh.).....	<i>Santalum album</i> L.
Sandal-i-surkh (Teh.).....	<i>Pterocarpus santalinus</i> L.
Sandalūs (Ind. bazaars).....	<i>Trachylobium Hornemannianum</i> Hayne
Sang-i-marjan (Hind.).....	<i>Corallium rubrum</i> Lam.
Sang-i-sar-i-māhi (Ind.).....	<i>Percomorphi, Sciaendae</i>
Sang-i-shadnaj (Afg.).....	<i>Nummulites</i> sp.
Sang-i-yahuda (Pers.).....	<i>Cidaris</i> sp.
Sanjirahut (Sans.).....	Calcium Sulphate
Sansaq (Ar.).....	<i>Stachys lavandulaefolia</i> Vahl
Saosafid (Ait.).....	<i>Gypsophila paniculata</i> L.
Sapistān (Pers.).....	<i>Cordia Myxa</i> L.

Sarcocolla (Gr.).....	<i>Astragalus fasciculaefolius</i> Boiss.
Sarish	<i>Eremurus Aucherianus</i> Boiss.
Sarsand (Bal.).....	<i>Salvia Hydrangea</i> DC.
Sarsun (Hind.).....	<i>Brassica campestris</i> L. var. <i>Napus</i> Bab.
Sarwali (Hind.).....	<i>Celosia argentea</i> L.
Satanj (Punj.).....	<i>Nummulites</i> sp.
Satari (Hind.).....	<i>Ruta graveolens</i> L.
Satarmul (Hind.).....	<i>Asparagus adscendens</i> Roxb.
Satavar (Hind.).....	<i>Asparagus adscendens</i> Roxb.
Sawa (Hind.).....	<i>Peucedanum graveolens</i> Benth. & Hook. (p. 148)
Sebestan (Pers.).....	<i>Cordia Myxa</i> L.
Seetere (Schl.).....	<i>Thymus Serpyllum</i> L. var. <i>Kotschyanus</i> Boiss.
Seid (Sud.).....	<i>Cyperus rotundus</i> L.
Sek binedge (Schl.).....	<i>Ferula persica</i> Willd.
Sekran (Syr.).....	<i>Withania Somnifera</i> Dunal
Semen Bardanae (English Herbal 1730).....	<i>Arctium Lappa</i> L.
Semen Basilici (Old Herbals).....	<i>Ocimum Basilicum</i> L.
Sem. Cichorii (Ph. Pers.).....	<i>Cichorium Intybus</i> L.
Sepistān (Teh.).....	<i>Cordia Myxa</i> L.
Sesbaniyah (Iraq).....	<i>Sesbania aculeata</i> Poir.
Seta Kundura (Hind.).....	<i>Boswellia Carterii</i> Bird.
Shabbīt (Ar.).....	<i>Peucedanum graveolens</i> Benth. & Hook. (p. 148)
Shāf-i-mamītā (Teh.).....	<i>Clyster</i>
Shaftal (Punj., Bal.).....	<i>Trifolium repens</i> L.
Shagāgi (Teh.).....	<i>Trachydium Lehmanni</i> Benth.
Shāhdānej-i-'adasī (Teh.).....	<i>Nummulites</i> sp.
Shahdeve (Hind.).....	<i>Chrozophora verbascifolia</i> Juss.
Shahi (Leh.).....	See <i>Saccharum officinarum</i> L.
Shahna (Bal.).....	<i>Pistacia vera</i> L.
Shahtarraḥ (Pers.).....	<i>Fumaria parviflora</i> Lam.
Shāh-tūt (Pers.).....	<i>Morus nigra</i> L.
Sha'ir	<i>Hordeum</i> sp.
Sha'ir Abū Sikkatain (Ar.).....	<i>Hordeum</i> sp.
Sha'ir Abū Sūwaif (Ar.).....	<i>Hordeum</i> sp.
Sha'irah	<i>Hordeum</i> sp.
Sha'ir Sparqālān (Ar.).....	<i>Hordeum</i> sp.
Shakakula micari (Hind.).....	<i>Asparagus adscendens</i> Roxb.
Shakar (Pers.).....	<i>Saccharum officinarum</i> L.
Shakar-i-surkh (Teh.).....	<i>Saccharum officinarum</i> L.
Shakar tīqāl (Teh.).....	<i>Echinops persicus</i> Stev.
Shākhah-i-marjān (Teh.).....	<i>Corallium rubrum</i> Lam.
Shakr-ul-ashar (Pers.).....	<i>Cotoneaster nummularia</i> Fisch. & Mey.
Shambalilah (Teh.).....	<i>Trigonella Foenum-graecum</i> L.
Shami (Iraq).....	<i>Citrullus vulgaris</i> Schrad.
Shams-wa-qamar (Iraq).....	<i>Helianthus annuus</i> L.
Shar-al-anat (Iraq).....	<i>Adiantum Capillus-Veneris</i> L.
Shātarrah (Teh., Isf.).....	<i>Fumaria parviflora</i> Lam.
Sha'ur	<i>Hordeum</i> sp.
Sheb (Bagh., Iraq).....	Alum
Shekakul (Teh.).....	<i>Trachydium Lehmanni</i> Benth.
Shijar (Iraq).....	<i>Cucurbita Pepo</i> DC.
Shilib (Turk.).....	<i>Oryza sativa</i> L.
Shinah Azqhi (Bal.).....	<i>Datura Stramonium</i> L.
Shingir gaz	<i>Tamarix pentandra</i> Pall.
Shirias	<i>Eremurus Aucherianus</i> Boiss.

Shir Kalan (Teh.).....	<i>Acanthophyllum squamosum</i> Boiss.
Shir Khisht (Teh.).....	<i>Cotoneaster nummularia</i> Fisch. & Mey.
Shir-milk (Pers.).....	<i>Cotoneaster nummularia</i> Fisch. & Mey.
Shir-zād (Teh.).....	<i>Lecanora esculenta</i> Eversm.
Shitaraj (Teh.).....	<i>Plumbago rosea</i> L.
Shivit (Isf.).....	<i>Peucedanum graveolens</i> Benth. & Hook.
Shok (Ar.).....	<i>Prosopis Stepaniana</i> Kunth
Shorah (Hind.).....	Potassium Nitrate
Shudnuj udsee (Ar.).....	<i>Nummulites</i> sp.
Shūrah-i-qalam (Teh.).....	Potassium Nitrate
Shuwairib.....	<i>Hordeum</i> sp.
Shuwandar sukari (Iraq).....	<i>Beta vulgaris</i> L.
Siah gaz.....	<i>Tamarix articulata</i> Vahl (p. 176)
Sibar (Ar.).....	<i>Aloe Perryi</i> Baker
Silaigh (Iraq).....	<i>Beta vulgaris</i> L.
Silajjah (Iraq).....	<i>Beta vulgaris</i> L.
Silajatu (Sans.).....	Mummy
Silajit (Hind.).....	Mummy
Siliq (Turk.).....	<i>Beta vulgaris</i> L.
Sim (Hind.).....	<i>Dolichos Lablab</i> L.
Simbi (Sans.).....	<i>Dolichos Lablab</i> L.
Simsim (Iraq).....	<i>Sesamum indicum</i> L.
Sindur (Bom.).....	Plumbi Oxidum
Sinjad-i-talkh (Teh., Isf.).....	<i>Melia Azedarach</i> L.
Sinn-aj-jamal.....	<i>Triticum</i> sp.
Sinn-al-fil.....	<i>Triticum</i> sp.
Sipand (Teh.).....	<i>Peganum Harmala</i> L.
Sipi (Hind.).....	<i>Cypraea moneta</i> L.
Sir (Teh., Iraq).....	<i>Allium sativum</i> L.
Siris.....	<i>Eremurus Aucherianus</i> Boiss.
Sirish-i-narm.....	<i>Eremurus Aucherianus</i> Boiss.
Sirish-i-safid (Isf., Teh.).....	<i>Eremurus Aucherianus</i> Boiss.
Siyāh-danan (Teh.).....	<i>Nigella sativa</i> Sibth.
Siyāh-tukhmah (Teh.).....	<i>Nigella sativa</i> Sibth.
So-ad (Ham.).....	<i>Cyperus rotundus</i> L.
Som (Ar.).....	<i>Allium sativum</i> L.
Soo'juch (Kurd.).....	<i>Vitis vinifera</i> L.
Sopari (Hind.).....	<i>Areca Catechu</i> L.
Soyah (Hind.).....	<i>Peucedanum graveolens</i> Benth. & Hook.
Spati-kari (Sans.).....	Alum
Spistha (Afg.).....	<i>Medicago sativa</i> L.
Stigu (Afg.).....	<i>Prunus Armeniaca</i> L.
Subz-i-gulanj (Teh.).....	<i>Pistacia Khinjuk</i> Stocks.
Sudāb (Teh.).....	<i>Ruta graveolens</i> L.
Sudaba (Ar.).....	<i>Ruta graveolens</i> L.
Sufeda (Hind.).....	Plumbi Carbonas
Sufed musli (Bom.).....	<i>Asparagus adscendens</i> Roxb.
Sufid pathar (Hind.).....	Calcium Sulphate
Sukhur.....	<i>Pistacia Trebinthus</i> L.
Sumbul (Teh.).....	<i>Ferula Sumbul</i> Hook. f.
Sumbul-i-latif (Teh., Isf.).....	<i>Nardostachys Jatamansi</i> DC.
Sumbul-jibali (Ar.).....	<i>Nardostachys Jatamansi</i> DC.
Sumbulu'l-tib (Teh., Isf.).....	<i>Nardostachys Jatamansi</i> DC.
Sumgh alucha (Pers.).....	See <i>Prunus Cerasus</i> L.
Summāq (Teh.).....	<i>Rhus coriaria</i> L.

- Summāq-i-shakki bī hastah (Teh.)... *Rhus coriaria* L.
 Surinjan..... See *Merendera persica* Boiss.
 Surinjan-i-kirmānī (Teh.)..... *Colchicum luteum* Baker and *C. speciosum* Stev.
 Surinjan-i-shirin (Ind. bazaars)..... See *Merendera persica* Boiss.
 Sūrinjān-i-sufrāh shudah (Teh.)... *Merendera persica* Boiss.
 Surinjan-i-talkh (Pers.)..... *Colchicum luteum* Baker and *C. speciosum* Stev.
 Sur-kūk (Afg.)..... *Testudo horsfieldii* Grey and *T. graeca*
 Surmah (Pers.)..... Antimonium Sulphidum
 Surma-ka-pathar (Hind.)..... Antimonium Sulphidum
- Tabashir (Ind. bazaars)..... *Bambusa arundinacea* L.
 Tabashira (Ar.)..... *Bambusa arundinacea* L.
 Tabāshīr-i-qalamī (Teh.)..... *Bambusa arundinacea* L.
 Tāj-i-khūrūs (Teh.)..... *Amaranthus paniculatus* L.
 Tāj-i-rizī (Teh.)..... *Solanum nigrum* L.
 Takmeria (Bom.)..... *Ocimum Basilicum* L.
 Talispatra (Hind.)..... *Taxus baccata* L.
 Talkak (?) (Iraq)..... *Quercus lusitanica* Lam. var. *tauricola*
 Tambaku (Afg.)..... *Nicotiana Tabacum* L. and *N. rustica* L.
 Tambrā nagkeshur (Pers.)..... *Ochrocarpus longifolius* Benth. & Hook.
 Tamr..... *Phoenix dactylifera* L.
 Tannum (Ar.)..... *Chrozophora verbascifolia* Juss.
 Tāpālaq (Teh.)..... *Cyperus rotundus* L.
 Tar-anjubin (Pers.)..... *Alhagi camelorum* Fisch. (also p. 162)
 Tara tezak (Afg.)..... *Lepidium sativum* L.
 Tarbuz (Teh.)..... *Citrullus vulgaris* Schrad.
 Tarrah (Pers.)..... *Fumaria parviflora* Lam.
 Tartak (Hind.)..... *Rhus coriaria* L.
 Tavi misri (Leh.)..... See *Saccharum officinarum* L.
 Tawak (Kurd.)..... *Celtis Tournefortii* Lam. (p. 97)
 Terengamisk (?) (Teh.)..... *Calaminiha graveolens* Benth.
 Thebba (Iraq)..... See *Nicotiana Tabacum* L. and *N. rustica* L.
 Thum (Turk.)..... *Allium sativum* L.
 Til (Hind.)..... *Sesamum indicum* L.
 Timan (Iraq)..... *Oryza sativa* L.
 Tin..... *Ficus Carica* L.
 Tirsh (Kurd.)..... *Rhus coriaria* L.
 Tochme Kertchec (Schl.)..... *Ricinus communis* L.
 Towdri (Hind.)..... *Sisymbrium Sophia* L.
 Tribolia (modern Gr.)..... *Tribulus terrestris* L.
 Triorit (Sans.)..... *Ipomoea Turpethum* R. Br.
 Triputa (Sans.)..... *Ipomoea Turpethum* R. Br.
 Tuber Chinae..... *Smilax China* L. and *S. glabra* Roxb.
 Tu fu ling (Chin.)..... *Smilax China* L. and *S. glabra* Roxb.
 Tukhm-chirbatī (Schl.)..... *Ocimum canum* Sims
 Tukhm-i-anjurah (Teh.)..... *Salvia macrosiphon* Boiss.
 Tukhm-i-bābūnāh (Teh.)..... *Matricaria Chamomilla* L.
 Tukhm-i-bādanjān (Teh.)..... *Solanum xanthocarpum* Schr. & Wend. and *S. Melongena* L.
 Tukhm-i-bārhang (Ham.)..... *Plantago major* L.
 Tukhm-i-bazrak (Ham.)..... *Linum usitatissimum* L.
 Tukhm-i-bihdānah (Teh.)..... *Pyrus Cydonia* L.
 Tukhm-i-chuqundur (Teh.)..... *Beta vulgaris* L.
 Tukhm-i-garmak (Teh.)..... *Citrullus vulgaris* Schrad.
 Tukhm-i-gishnīz (Teh.)..... *Coriandrum sativum* L.

- Tukhm-i-havij (Teh.).....*Daucus Carota* L.
 Tukhm-i-hummāz (Teh., Ham.)...*Rumex conglomeratus* L. and *R. obtusifolius* L.
 Tukhm-i-iblis (Teh.).....*Caesalpinia Bonducella* Roxb.
 Tukhm-i-isfand (Teh.).....*Peganum Harmala* L.
 Tukhm-i-ispānāj (Teh.).....*Spinacia oleracea* L.
 Tukhm-i-jinjak (Ait.).....*Prosopis Stephaniana* Kunth
 Tukhm-i-kadu (Teh.).....*Cucurbita Pepo* DC.
 Tukhm-i-kadū qalyānī (Teh.)....*Lagenaria vulgaris* Ser.
 Tukhm-i-kāfshah (Teh., Ham.)....*Carthamus tinctorius* L.
 Tukhm-i-kāhū (Teh.).....*Lactuca sativa* L.
 Tukhm-i-kalam (Teh.).....*Carum Petroselinum* Benth. & Hook.
 Tukhm-i-karafs (Teh.).....*Apium graveolens* L.
 Tukhm-i-kāsni (Ham., Teh.).....*Cichorium Intybus* L.
 Tukhm-i-katan (Ait.).....*Linum usitatissimum* L.
 Tukhm-i-keshus (Pers.).....*Cuscuta planifolia* Ten. and *C. hyalina* Roth
 Tukhm-i-khābāzi (Teh.).....*Malva sylvestris* L. var. *mauritanica* Boiss.
 Tukhm-i-khāk-i-shir (Ham.).....*Erysimum repandum* L.
 Tukhm-i-khākshir talkh.....*Erysimum* sp. (p. 171)
 Tukhm-i-khardal (Teh., Ham.)....*Salvia* sp.
 Tukhm-i-khash khāsh.....*Papaver somniferum* L.
 Tukhm-i-khatmī (Isf.).....*Althaea* sp.
 Tukhm-i-khatmī.....*Althaea lavateraefolia* DC.
 Tukhm-i-khiyār (Teh.).....*Cucumis sativus* L.
 Tukhm-i-kishavar (Ham., Isf., Teh.).....*Cuscuta planifolia* Ten. and *C. hyalina* Roth
 Tukhm-i-kushūth (Ham., Isf., Teh.).....*Cuscuta planifolia* Ten. and *C. hyalina* Roth
 Tukhm-i-lāk-pusht (Teh.).....*Testudo horsfieldii* Grey and *T. graeca*
 Tukhm-i-lāl'abbās (Teh.).....*Mirabilis Jalapa* L.
 Tukhm-i-livās (Ham., Teh.).....*Rheum Ribes* L.
 Tukhm-i-marv (Teh.).....*Salvia macrosiphon* Boiss.
 Tukhm-i-mūrd (Teh.).....*Myrtus communis* L.
 Tukhm-i-nil.....*Ipomoea hederacea* Jacq.
 Tukhm-i-nilūfar (Teh.).....*Ipomoea hederacea* Jacq.
 Tukhm-i-piyāz (Teh.).....*Allium Cepa* L.
 Tukhm-i-raihān (Ham., Teh.)....*Ocimum Basilicum* L.
 Tukhm-i-rāziyānah (Teh., Ham.)...*Foeniculum vulgare* Mill.
 Tukhm-i-shabdar (Teh.).....*Trifolium repens* L.
 Tukhm-i-shaga'ig (Ham.).....*Papaver somniferum* L.
 Tukhm-i-shāhī (Teh.).....*Lepidium sativum* L.
 Tukhm-i-shalgham (Teh.).....*Brassica campestris* L. var. *Napus* Bab.
 Tukhm-i-shamballāh (Teh., Ham.)...*Trigonella Foenum-graecum* L.
 Tukhm-i-sharbatī (Ham., Teh.)....*Ocimum canum* Sims
 Tukhm-i-shātarrah (Ham.).....*Fumaria parviflora* Lam.
 Tukhm-i-shivīd (Teh.).....*Peucedanum graveolens* Benth. & Hook.
 Tukhm-i-siyāh (Teh.).....*Nigella sativa* Sibth.
 Tukhm-i-tamr (Teh.).....*Tamarindus indica* L.
 Tukhm-i-tarrah (Teh.).....*Allium sativum* L.
 Tukhm-i-turi (Afg.).....*Luffa acutangula* Roxb.
 Tukhm-i-turubchah (Teh.).....*Raphanus sativus* L.
 Tukhm-makhtum (Punj.).....*Sigillated Earth*
 Tukhm-tāj-i-khurūs (Isf.).....*Amaranthus paniculatus* L.
 Tukhm tartizak (Isf.).....*Lepidium sativum* L.
 Tukhm-tātūrā (Pers.).....*Datura Stramonium* L.
 Tukhm-zabān-i-gunjishk-i-talkh (Pers.).....*Holarrhena antidysenterica* Wall.

- Tukhm zardak (Teh.)..... *Daucus Carota* L.
 Tukhm zireh (Teh.)..... *Carum Bulbocastanum* Koch
 Tuklejah(?) (Ham.)..... *Stachys germanica* L.
 Turnaku..... *Nicotiana Tabacum* L. and *N. rustica* L.
 Tur (Kurd.)..... *Raphanus sativus* L.
 Turb (Pers.)..... *Raphanus sativus* L.
 Turbad (Leh.)..... *Ipomoea Turpethum* R. Br.
 Turbud (Teh.)..... *Ipomoea Turpethum* R. Br.
 Tūrī (Teh.)..... *Luffa acutangula* Roxb.
 Tut-i-dham (Pers.)..... *Morus nigra* L.
 Tüt-i-kushk (Teh.)..... *Morus nigra* L.
 Tütün (Iraq)..... *Nicotiana Tabacum* L. and *N. rustica* L.

 Udasaliyun (Gr.)..... *Apium graveolens* L.
 'Ud-i-balsān (Isf.)..... *Commiphora opobalsamum* Kunth
 'Unnāb (Iraq)..... *Zizyphus vulgaris* L.
 'Unnāb (Teh.)..... *Zizyphus vulgaris* L.
 Urd (Ind.)..... *Phaseolus radiatus* L.
 Urid (Ind.)..... *Phaseolus radiatus* L.
 Uruk-el-kafur (Ar.)..... *Curcuma Zedoaria* Roxb. and *C. Zerumbet* Roxb.
 Ushna ushek (Pers.)..... *Dorema Ammoniacum* Don
 Ustūkhūdūs (Teh.)..... *Lavandula dentata* L.
 Uurd (Abu Mansur)..... *Myrtus communis* L.
 Uzarih (Turk.)..... *Peganum Harmala* L.

 Vālik (Teh.)..... *Allium Akaka* Gmel.
 Vashā (Teh.)..... *Dorema Ammoniacum* Don
 Vetiver (Tam.)..... *Vetiveria zizanioides* Stapf
 Vrishanasana (Sans.)..... *Embelia Ribes* Burm.

 Warch (Punj.)..... *Acorus Calamus* L.
 Ward (Ar.)..... *Rosa damascena* Mill.
 Ward (Ar.)..... *Rosa hemisphaerica* Herm.
 Ward-ash-shams (Iraq)..... *Helianthus annuus* L.
 Wasma (Punj., Pers., Turkey)..... *Indigofera tinctoria* L.
 Welec, See Valik
 Weleque, See Valik
 Winjah (Kurd.)..... *Medicago sativa* L.
 Wodak (Bal.)..... *Tulipa montana* Lindl.
 Wuda (Ar.)..... *Cypripedium moneta* L.

 Yunjah (Kurd.)..... *Medicago sativa* L.

 Za'adi..... *Phoenix dactylifera* L.
 Za'farān (Teh.)..... *Crocus sativus* L.
 Zaeteran (Boiss.)..... *Thymus* sp.
 Zafran (Ar.)..... *Crocus sativus* L.
 Zagher (Ait., Afg.)..... *Linum usitatissimum* L.
 Zahar (Iraq)..... *Anamirta paniculata* Coleb.
 Zaitūn..... *Olea europea* L.
 Zāj-u-saffd (Teh.)..... Alum
 Zalil (Iran)..... *Delphinium Zalil* Ait. & Hemsl.
 Zamchi (Turk.)..... Alum
 Zanjabil chami..... *Inula Helenium* L.
 Zanjabil-i-shami..... *Inula Helenium* L.
 Zarāvand-i-gird (Pers.)..... *Aristolochia rotunda* L.

Zarāvand-i-tavīl (Ham., Teh.)	<i>Aristolochia longa</i> L.
Zard ālū (Pers.)	<i>Prunus Armeniaca</i> L.
Zard chobah (Pers.)	<i>Curcuma domestica</i> Val. and <i>C. longa</i> Trim.
Zarishk (Hind., Bom.)	<i>Berberis vulgaris</i> L.
Zarnab (Isf., Ar.)	<i>Taxus baccata</i> L.
Zārnīckh-i-dandan (Teh.)	Arsenic Trisulphide
Zarnīkh (Teh.)	Arsenic Trisulphide
Zārnīkh-zard (Isf.)	Arsenic Trisulphide
Zatar (Syr., Iraq)	<i>Thymus Serpyllum</i> L. var. <i>Kotschyanus</i> Boiss.
Zatar (Teh.)	<i>Zataria multiflora</i> Boiss. (also pp. 174, 178)
Zatar farisi (Boiss.)	<i>Thymus</i> sp.
Ziniyān (Teh., Ham.)	<i>Carum copticum</i> Benth. & Hook.
Zīra (Hind.)	<i>Cuminum Cyminum</i> L.
Zīrah-i-sabz (Isf., Iraq)	<i>Cuminum Cyminum</i> L.
Zīreh-siyah (Isf.)	<i>Carum Bulbocastanum</i> Koch
Zirishk (Bagh.)	<i>Berberis vulgaris</i> L.
Zirishk-i-gulī (Ham., Teh.)	<i>Berberis vulgaris</i> L.
Zirishk-tursh (Punj.)	<i>Berberis vulgaris</i> L.
Ziwan (Iraq)	<i>Lolium rigidum</i> Gaud.
Zūfā (Teh.)	<i>Nepeta micrantha</i> Bunge and <i>N. ispahanica</i> Boiss.
Zufah-i-yabis (Ar.)	<i>Nepeta micrantha</i> Bunge and <i>N. ispahanica</i> Boiss.
Zuleh (Ham.)	<i>Gypsophila paniculata</i> L.
Zūnā (Teh.)	<i>Nepeta micrantha</i> Bunge and <i>N. ispahanica</i> Boiss.
Zunghari	<i>Pistacia Terebinthus</i> L.
Zupha-e-yabis (Ar.)	<i>Hyssopus officinalis</i> L. var. <i>angustifolia</i> Boiss.
Zuratspi (Kurd.)	<i>Sorghum vulgare</i> Pers.
Zurraij (Iraq)	<i>Chrozophora verbascifolia</i> Juss.
Zurunbād (Teh.)	<i>Curcuma Zedoaria</i> Roxb. and <i>C. Zerumbet</i> Roxb.

FLORA OF THE AGUAN VALLEY AND THE COASTAL REGIONS NEAR LA CEIBA HONDURAS

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FLORA OF THE AGUAN VALLEY AND THE COASTAL REGIONS NEAR LA CEIBA HONDURAS

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The plants listed on the following pages were collected on the coastal plain and mountain slopes in the vicinity of La Ceiba in the Department of Atlántida, Honduras, and also in a desert-like area in the Aguán River Valley near Coyoles in the Department of Yoro from June to August, 1938 by the writer accompanied by James Koepper and Kenneth Wagner.¹

Paul C. Standley² spent several months during the winter of 1927-28 studying the vegetation in the Lancetilla Valley and surrounding territory near the coastal town of Tela, which is situated approximately 75 kilometers west of La Ceiba. His publication upon that region is the only description of any importance so far made of the flora of this northern coastal plain area. Standley³ also published in 1930 a list of woody plants occurring in the vicinity of Siguatepeque in the interior of the country in the Department of Comayagua. Professor Record⁴ in 1927 published a list of the trees then known to occur in Honduras. During the summer of 1934 the writer made collections in the Lancetilla Valley region, at Potrerillos, and about Lake Yojoa, in the Department of Cortés. In the summer of 1936, in company with Ray Dawson and Howard Youse, collections were made also in the mountains in the vicinity of Siguatepeque. The results of this work were published in 1938.⁵ So far as known, aside from a few small collections and the descriptions of occasional new species or short articles, no other publications have been made on the flora of Honduras.

Botanically speaking, Honduras is, therefore, one of the least known of the Central American countries, although it presents unusual opportunities for exploration. While roads suitable for automobile traffic are few, the more important cities in the interior can be reached easily by airplane. Trails are numerous, and by using

¹ See T. G. Yuncker, Notes on a semi-arid region in the Aguán River Valley Republic of Honduras, *Torreya* 39: 133-139. 1939.

² *Field Mus. Bot.*, 10. 1931.

³ *Journ. Arnold Arb.* 9, No. 1. 1930.

⁴ *Tropical Woods*, No. 10. June, 1927.

⁵ *Field Mus. Bot.*, 17, No. 4. 1938.

mules most regions are accessible. With the exception of the coastal regions, which are generally warm and humid, the climate is pleasant and work can be carried on in comfort.

Honduras, which lies between Guatemala and Salvador on the west and Nicaragua on the southeast, is irregularly triangular in outline, with the apex at the Gulf of Fonseca on the Pacific Ocean and with the base forming the northern coast along the Caribbean Sea. The country is rough and mountainous, with the principal ranges extending in an east-west direction through the south-central part of the country. Near the northern coast a secondary range, which includes some peaks reported to be more than 2,000 meters in height, extends from the Ulúa River on the west to the town of Trujillo on the east. Between this range and the Caribbean lies a fertile coastal plain. In a few places the mountains extend to within a very short distance of the sea but elsewhere, especially where rivers occur, the plain is several kilometers wide. A number of rivers rise in the mountains of the interior and have their outlets in the Caribbean, the largest and most important of which are the Ulúa and the Aguán. Some of the smaller streams, which may be insignificant during the dry season, become torrents when there is an abundance of rain. The rich soil of the coastal plain and river valleys of the northern coast, together with the warm, humid climate, present conditions suitable for the cultivation of tropical fruits, especially bananas, and it is here that the great fruit companies have developed extensive plantations.

For the most part the coastal plain contains but little of the original vegetation. Large areas have been cleared for banana plantations, for smaller native farms (*poquiteros*), and for grazing. In preparing the land for planting bananas all the trees are cut and burned or allowed to decay where they fall. On the small native farms and elsewhere, however, one may find occasional specimens of some of the larger forest trees remaining. Plant growth is extremely rapid, and where cultivation has been discontinued the vegetation soon becomes luxuriant and often practically impenetrable. Another factor in the extermination of the forest trees is the utilization by the residents of large numbers of trees for fuel. In places native clearings (*milpas*) also have been made on the lower slopes of the mountains, but these are not numerous and are mostly small. The soil in such virgin clearings generally produces good crops for a few years, but as the fertility diminishes a new clearing is made and the old one allowed to revert to the natural state. These hillside plan-

tations secure more light for their crops because of the slope which reduces the shade from the surrounding forest.

La Ceiba is the largest town on the northern coast of Honduras and is the principal port and headquarters of the Standard Fruit Company. The coastal plain is comparatively narrow in the vicinity of La Ceiba, with the mountains forming a series of high and picturesque peaks, known locally as the Cangrejal Range. As seen from the sea, La Ceiba with its background of high and almost continually cloud-capped peaks presents a very beautiful scene. The mountains



FIG. 1. The cloud-draped peaks of the Cangrejal Range, back of La Ceiba.

rise directly from the plain with few or no foothills and with the windward or northern slopes facing the Caribbean Sea densely covered with virgin rain forest. The trees are mostly 50 to 100 feet tall, but here and there are giant trees which tower above the lower main forest canopy. Beneath the dominant upper layer occurs a dense growth of smaller trees, palms, shrubs, and lianas through which but little sunlight penetrates. Large numbers of orchids, bromeliads, cacti, and other epiphytic plants are present on the trees. The taller trees and many of the epiphytes are difficult or impossible to collect without cutting the trees which, in the case of the larger species, is usually not practicable. Occasional herbaceous plants such as peperomias, begonias, ferns, etc., together with fallen trees and other rotting debris make up the forest floor.

The denseness of the vegetation, which requires the continual use of a machete to penetrate it and the consequent impossibility of being able to see for any distance and determine directions, together with the numerous deep canyons and precipitous walls, make the ascent of the higher mountains in this region extremely difficult. It is claimed that some of the highest peaks never have been scaled. One is ordinarily able to make better progress, espe-



FIG. 2. Mountains near the village of Las Flores, Department of Yoro.

cially on the lower slopes, by following the rock-filled courses of some of the smaller streams. It is believed by aviators who fly over the range that an ascent may be more easily made from the opposite or windward side, where the vegetation is not so dense and the mountain slopes less precipitous. Doubtless many plants of considerable interest will be discovered at the higher elevations when collections are made there.

The Aguán River, which originates in the interior of the Department of Yoro, flows in a northeasterly direction to the sea through a progressively widening valley. Along the river occurs a low, flat zone of varying width, known as vega land, composed of rich soil annually inundated during the rainy season and on which bananas are now grown extensively. In some places this vega land is very narrow, but elsewhere it is wide enough to support banana plantations of considerable size. From this low region the land rises very

abruptly to a height of about 20 meters to form a flat mesa or plateau-like tableland which with gradually increasing elevation extends for several kilometers to the foothills of the adjacent mountains. On this tableland, from near Olanchito up the river to Coyoles and beyond for a number of kilometers, occurs a unique desert-like area. This region lies behind the coastal range of mountains, which prevent the clouds from the Caribbean reaching the interior with their moisture. The rainfall may be adequate here during the rainy season but in the dry season water is scarce and the vegetation becomes dry and parched. In places the people have dug irrigation ditches to provide sufficient moisture for their grazing



FIG. 3. The Salado River, about 20 km. west of La Ceiba.

lands, and the fruit company likewise is compelled to irrigate its banana plantations for part of the year.

Much of the vegetation of the tableland is characteristic of arid regions. A number of species of cacti, some of which become giant, tree-like forms 10 to 15 meters in height, are common. In places the land has been entirely cleared and converted into pasture, but in other areas scattered groves of trees, mostly leguminous, occur. In the vicinity of Coyoles there are areas where the vegetation appears to be more virgin, with large ceiba, guanacaste, and other species occurring scattered in a forest made up mostly of small trees and shrubs. Epiphytes, especially orchids, bromeliads, and cacti, are

exceptionally abundant, though the number of species does not seem to be large. Herbaceous plants are scarce, undoubtedly in part because of the arid conditions and in part because of the grazing of large numbers of animals which range at will throughout the forest. Most of the trees have a gray or light-colored bark, which together with the dry, grayish, and dusty soil and rather sparse foliage imparts a weird and ghost-like character to the landscape.

As one approaches the foothills, the composition of the vegetation gradually changes. A species of large palm is common in open,



FIG. 4. Aguán River Valley, near Olanchito.

grassy areas and several species of oaks and a pine form an open forest extending up the slopes, on whose floor grow numerous species of grasses, sedges, and other herbaceous plants. By continuing over a series of foothills, one approaches the coastal, or Cangrejal range lying back of La Ceiba, and, as viewed from a distance, the forest appears to be more open than on the windward slopes. It is likely that the summit could be reached more easily from this side, although lack of sufficient time prevented our making the attempt.

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LIST OF GENERA AND SPECIES

SCHIZAEACEAE

LYGODIUM Swartz

Lygodium venustum Swartz. Climbing over shrubs. Common in thickets on both windward and leeward slopes of the coastal range of mountains.

GLEICHENIACEAE

DICRANOPTERIS Bernh.

Dicranopteris bifida (Willd.) Maxon. Stems long and much branched. Overhanging the bank of a moist, shaded ravine on the lower slopes of Mt. Cangrejal. Not common.

Dicranopteris pectinata (Willd.) Underw. Associated with *D. bifida* on the bank of a ravine on the lower slopes of Mt. Cangrejal. Observed but once and apparently uncommon in this region.

HYMENOPHYLLACEAE

TRICHOMANES L.

Trichomanes Krausii Hook. & Grev. On a rock in deep, wet forest on the lower slopes of Mt. Cangrejal at about 330 meters altitude.

CYATHEACEAE

ALSOPHILA R. Br.

Alsophila blechnoides (Rich.) Hook. Leaves up to 2 meters in length. At edge of thicket on the lower slopes of Mt. Cangrejal.

Alsophila microdonta Desv. Leaves about 2 meters in length. In low, wet soil on the bank of the Salado River, west of La Ceiba.

Alsophila Schiedeana Presl. Trunk about 3 meters tall, spiny; petioles spiny and with numerous brown scales. On the bank of a mountain stream back of La Ceiba. Not common in this region.

HEMITELIA R. Br.

Hemitelia costaricensis (Klotzsch) Mett. Trunk about 6 meters tall. In moist forest on the lower slopes of Mt. Cangrejal. Not common in this region.

POLYPODIACEAE

ACROSTICHUM L.

Acrostichum daneaefolium Langsd. & Fisch. Plants large, 1 to 2 meters tall. Common in low, marshy areas on the coastal plain.

ADIANTUM L.

Adiantum latifolium Lam. In rich soil, on shaded stream bank, foothills back of La Ceiba.

Adiantum petiolatum Desv. Abundant in rich soil, shady stream bank, and side of trail in foothills back of La Ceiba.

Adiantum pulverulentum L. Leaves up to 75 cm. long. In moist thicket, foothills back of La Ceiba.

Adiantum Seemanni Hook. Pinnules up to 7 cm. long and 4.5 cm. wide. In deep, shady ravine on slope near Puente Alto, about 50 kilometers east of La Ceiba, at 250 meters altitude.

Adiantum tetraphyllum H. & B. In moist, shady ravine on foothills back of La Ceiba.

Adiantum trapeziforme L. An attractive species with leaves up to 75 cm. long. On rich soil, in shady, wet ravine in the foothills above the village of Medina.

Adiantum Wilesianum Hook. In rocky ravine of a mountain stream near Puente Alto, about 50 kilometers east of La Ceiba, at 300 meters altitude.

ANANTHACORUS Underw. & Maxon

Ananthacorus angustifolius (Swartz) C. Chr. On a rock, edge of mountain stream, slopes of Mt. Cangrejal back of La Ceiba, at 360 meters altitude.

ASPLENIUM L.

Asplenium auritum Swartz. On mossy rocks at the edge of a mountain stream, on the slopes of Mt. Cangrejal, back of La Ceiba, at 300 meters altitude.

Asplenium formosum Willd. On mossy rocks at edge of a mountain stream on the slopes of Mt. Cangrejal, back of La Ceiba.

BLECHNUM L.

Blechnum occidentale L. On shady stream bank, foothills back of La Ceiba.

BOLBITIS Schott

Bolbitis cladorrhizans (Spreng.) Ching. On the rocky bank of the Danto River, lower slopes of Mt. Cangrejal.

Bolbitis Donnell-Smithii (Christ) Ching. On moist, shady stream bank, lower slopes of Mt. Cangrejal.

CYCLOPELTIS J. Sm.

Cyclopeltis semicordata (Swartz) J. Sm. A large, coarse fern with leaves up to 1 meter in length; stipe coarsely hairy or scaly. Common in thickets on the foothills back of La Ceiba; also in a rocky ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 270 meters altitude.

DRYOPTERIS Adans.

Dryopteris angustifolia (Willd.) Urban. In thin soil, rocky edge of mountain stream on the lower slopes of Mt. Cangrejal, back of La Ceiba.

Dryopteris Ghiesbreghtii (Linden) C. Chr. On shady stream bank, foothills back of La Ceiba.

Dryopteris Jurgensenii (Fée) Maxon & Morton. Leaves up to 1 meter in length. At edge of thicket, lower slopes of Mt. Cangrejal, back of La Ceiba.

Dryopteris normalis C. Chr. Very common along streams, on mossy rocks, or in soil.

Dryopteris panamensis (Presl) C. Chr. Very common along streams, on mossy rocks, or in soil.

Dryopteris patens (Swartz) Kuntze. Leaves up to 1 meter in length. On a rocky cliff, margin of stream, back of La Ceiba.

Dryopteris resiliens Maxon. On the rocky bank of a mountain stream, back of La Ceiba.

Dryopteris serrata (Cav.) C. Chr. Plants large, with leaves up to 1 meter long. On low, wet bank of Salado River, about 20 kilometers west of La Ceiba.

Dryopteris Sprengelii (Kaulf.) Kuntze. Leaves up to 1 meter long. On shady stream bank, foothills back of La Ceiba; also in rocky ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 270 meters altitude.

Dryopteris subtetragona (Link) Maxon. In rich soil along the trail in forest on the lower slopes of Mt. Cangrejal, back of La Ceiba.

ELAPHOGLOSSUM Schott

At least three species of this genus were observed on tree trunks in deep, moist forest on the slopes of Mt. Cangrejal. Unfortunately, none were found in fruiting condition suitable for identification.

HEMIONITIS L.

Hemionitis palmata L. A low, terrestrial fern with characteristic palmately 5-lobed leaves. In rich soil, thicket on foothills back of La Ceiba. Locally abundant.

NEPHROLEPIS Schott

Nephrolepis biserrata (Swartz) Schott. Leaves up to 1 meter long. In rich, moist soil on the bank of the Salado River, about 20 kilometers west of La Ceiba.

Nephrolepis pendula (Raddi) J. Sm. Leaves narrow, 1 or more meters in length, pendent. Epiphytic on palms in open forest area near the village of Las Flores.

PITYROGRAMMA Link

Pityrogramma calomelanos (L.) Link. Very common. Leaves white-powdery on the lower surface. In thickets and on stream banks.

POLYPODIUM L.

Polypodium ciliatum Willd. Epiphytic. Sterile leaves 3 to 5 cm. long; fertile blades linear-oblong. On trees in forest on the foothills back of La Ceiba.

Polypodium costatum Kunze. On tree in forest, foothills back of La Ceiba.

Polypodium crassifolium L. Leaves about 1 meter long. Epiphytic on branch of tree on river bank, foothills back of La Ceiba.

Polypodium lycopodioides L. Creeping on trees in forest on the slopes of Mt. Cangrejal, at 300 meters altitude.

Polypodium Palmeri Maxon. Leaves oblong, up to 12 cm. in length and 4 cm. in width. Creeping on trees in forest, foothills back of La Ceiba; also on trees in semi-arid woodland near Coyoles.

Polypodium pectinatum L. On a mossy rock near the Cangrejal River back of La Ceiba; also in rich soil, bank of mountain stream near the village of Las Flores.

Polypodium percussum Cav. Leaves with narrowly attenuate apices and small, scattered scales on the lower surface. Creeping on tree trunks in forest on the slopes of Mt. Cangrejal back of La Ceiba.

Polypodium Phyllitidis L. Leaves up to 60 cm. long and 7 cm. wide. Epiphytic on tree in forest on rocky ridge back of Roma siding, about 25 kilometers east of La Ceiba, at 300 meters altitude.

Polypodium triseriale Swartz. On a rocky outcropping in open, forested area on mountain slope near the village of Las Flores, at 330 meters altitude.

PTERIDIUM Scop.

Pteridium caudatum (L.) Maxon. Leaves about 1 meter long and up to 90 cm. wide. Abundant in burned areas on mountain slope above Roma siding, about 25 kilometers east of La Ceiba.

TECTARIA Cav.

Tectaria dilacerata (Kunze) Maxon. Leaves about 1 meter long. Common along shady stream banks in foothills back of La Ceiba; also in open pine forest on rocky mountain slope above the village of Las Flores, at 330 meters altitude.

Tectaria heracleifolia (Willd.) Underw. In rich soil, moist, shady stream bank, slopes of Mt. Cangrejal back of La Ceiba; also in rocky ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

Tectaria martinicensis (Spreng.) Copel. Leaves about 1 meter long; stipe sparingly scaly at the base. In rich soil, foothills back of La Ceiba.

VITTARIA J. E. Sm.

Vittaria lineata (L.) J. E. Sm. Pendent from tree branch in forest along river bank on the foothills back of La Ceiba.

SALVINIACEAE

SALVINIA Schreb.

Salvinia rotundifolia Willd. Plants about 5 mm. in diameter. Floating on the surface of a pond near La Ceiba.

SELAGINELLACEAE

SELAGINELLA Beauv.

Selaginella cuspidata Link. On a mossy rock at edge of mountain stream, slopes of Mt. Cangrejal, back of La Ceiba.

Selaginella spp. Four or five additional species of this genus were collected, but as yet they have not been determined.

CYCADACEAE

ZAMIA L.

Zamia furfuracea L. f. Stemless and, so far as observed, with a solitary, pinnate leaf. Occasional in semi-arid woodland region near Coyoles.

PINACEAE

PINUS L.

Pinus caribaea Morelet. Trees 15 to 20 meters in height and up to 50 cm. in diameter. Associated with *Quercus* and other broad-leaved trees to form open, pine-oak forests on the leeward slopes of the coastal range.

ALISMACEAE

ECHINODORUS L. Rich.

Echinodorus macrophyllus (Kunth) Micheli. Conspicuous because of its large, more or less cordate leaves. In low, marshy areas on the coastal plain.

GRAMINEAE

ANDROPOGON L.

Andropogon bicornis L. A coarse grass 1 meter or more in height. In an open area on foothills back of La Ceiba.

CENCHRUS L.

Cenchrus echinatus L. In sandy soil on low land bordering the Aguán River in the vicinity of Coyoles.

Cenchrus pauciflorus Benth. A very common North American weed. In sand along the beach near the village of Salado, about 20 kilometers west of La Ceiba.

COIX L.

Coix Lachryma-jobi L. Not abundant in this region. A small clump found on a gravelly river bar in the foothills back of La Ceiba.

CYNODON Pers.

Cynodon Dactylon (L.) Pers. In sandy soil near La Ceiba. Frequently used as a lawn grass.

DIGITARIA Heist.

Digitaria horizontalis Willd. A common and widely distributed, weedy grass. Abundant along trails in the foothills back of La Ceiba.

ELEUSINE Gaertn.

Eleusine indica (L.) Gaertn. A common and widely distributed, weedy species. Along the trail on the lower slopes of Mt. Cangrejal, back of La Ceiba.

GYNERIUM Willd.

Gynerium sagittatum (Aubl.) Beauv. A tall, coarse grass with stems up to 6 or more meters in height. The handsome, plumose inflorescence up to 1 meter in length. Common in low, marshy ground along the Salado River, about 20 kilometers west of La Ceiba.

LASIACIS (Griseb.) Hitchc.

Lasiacis procerrima (Hack.) Hitchc. Stems coarse and up to 3 or more meters in length. In a thicket on the range above Roma siding, about 25 kilometers east of La Ceiba, at 300 meters altitude.

Lasiacis ruscifolia (HBK.) Hitchc. Stems slender, up to 2 meters in length. Scrambling over shrubs in a thicket on the lower slopes of Mt. Cangrejal.

OLYRA L.

Olyra latifolia L. Stems coarse, up to 2 meters in length; leaf blades broad, petiolate. Frequent in the foothills back of La Ceiba.

PANICUM L.

Panicum maximum Jacq. Stems up to 2 meters in height. Common in the foothills and plains about La Ceiba. Often planted for pasture.

Panicum pilosum Swartz. Common in open areas and along trails in the foothills.

Panicum polygonatum Schrad. Abundant along trails in the foothills.

Panicum trichoides Swartz. Frequent on the lower slopes of Mt. Cangrejal and on the plains.

Panicum zizanioides HBK. Occasional in open areas in the foothills near La Ceiba.

PASPALUM L.

Paspalum conjugatum Berg. A very common, weedy grass on the plains and in the foothills about La Ceiba.

Paspalum paniculatum L. Stems up to 1.5 meters in height. Common in low, marshy areas near La Ceiba.

Paspalum plicatulum Michx. A common and widely distributed species. In open places, foothills back of La Ceiba.

Paspalum virgatum L. Stems up to 2 meters in height. In low, marshy areas back of La Ceiba.

PHARUS L.

Pharus glaber HBK. Leaves broad, oblanceolate, attenuately acuminate, petiolate. In deep forest on the lower slopes of Mt. Cangrejal, back of La Ceiba.

SETARIA Beauv.

Setaria geniculata (Lam.) Beauv. An abundant and weedy species, common on the plains and in the foothills about La Ceiba.

SPOROBOLUS R. Br.

Sporobolus indicus (L.) R. Br. In open places in forest on the lower slopes of Mt. Cangrejal.

Sporobolus virginicus (L.) Kunth. In sandy soil near the beach at Salado, west of La Ceiba.

STENOTAPHRUM Trin.

Stenotaphrum secundatum (Walt.) Kuntze. Sometimes used as a lawn grass in the southern United States. In sandy soil near the beach at Salado, about 20 kilometers west of La Ceiba.

TRICHACHNE Nees

Trichachne insularis (L.) Nees. A rather coarse grass, up to 1 meter in height, with a handsome, plumose inflorescence. Common about La Ceiba; also on the bank of an irrigation canal in the Aguán River Valley near Coyoles.

CYPERACEAE**CALYPTROCARYA** Nees

Calyptrocarya glomerulata (Brongn.) Urban. Flowers in small glomerules which are arranged in loose, umbel-like clusters along the stem. On stream bank, slopes of Mt. Cangrejal, at 300 meters altitude.

CYPERUS L.

Cyperus articulatus L. The spongy, nearly leafless stems up to 1 meter in height. In boggy area near the seashore, vicinity of La Ceiba.

Cyperus caracasanus Kunth. Abundant along trails and in open places on the lower slopes of Mt. Cangrejal, back of La Ceiba.

Cyperus diffusus Vahl. Common in open, wet areas about La Ceiba.

Cyperus ferax L. Rich. Very common in low areas about La Ceiba.

Cyperus Luzulae (L.) Retz. Abundant in moist soil on the lower slopes of Mt. Cangrejal.

Cyperus rotundus L. Common on sandbars in the Aguán River above Olanchito.

DICHROMENA Michx.

Dichromena ciliata Vahl. Flowers in compact heads subtended by several linear, leaf-like bracts up to 10 cm. long and white within near the base. Scattered but abundant in rocky soil in open pine forest on mountain slope at 330 meters altitude, near the village of Las Flores.

ELEOCHARIS R. Br.

Eleocharis geniculata (L.) R. Br. Stems spongy, subterete, rush-like, leafless; spikes solitary and terminal. In low, wet area on the lower slopes of Mt. Cangrejal.

Eleocharis mutata (L.) R. & S. Stems nearly leafless, three-angled. In wet, marshy area near the seashore, vicinity of La Ceiba.

FIMBRISTYLIS Vahl

Fimbristylis spadicea (L.) Vahl. Common in low, sandy areas near the beach, vicinity of La Ceiba.

KYLLINGA Rottb.

Kyllinga peruviana Lam. Common in wet, boggy areas along the seashore in the vicinity of La Ceiba.

SCLERIA Berg

Scleria pterota Presl, var. **melaleuca** (S. & C.) Standl. Frequent in the foothills and on the plains about La Ceiba.

Scleria secans (L.) Urban. Stems slender, scrambling over low shrubs in thicket on bank of stream, slopes of Mt. Cangrejal, at 200 meters altitude.

PALMAE**ASTROCARYUM** Mey.

Astrocaryum mexicanum Liebm. Trunk about 3 meters tall, armed with flattened spines about 5 cm. long; spathe densely covered with needle-like spines 1-2 cm. long. In deep forest on slopes of Mt. Cangrejal, at 240 meters altitude.

CHAMAEDOREA Willd.

Chamaedorea graminifolia Wendl. Trunk smooth, slender, up to 6 meters in height; leaves pinnate, up to 2 meters in length. Bank of mountain stream, slopes of Mt. Cangrejal.

Chamaedorea Lindeniana Wendl. Trunk smooth, slender, up to 2.5 meters in height; leaves pinnate; branches of inflorescence and young fruit light orange color; fruit black when ripe. In forest on the slopes of Mt. Cangrejal; also in rocky ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 240 to 270 meters altitude.

Chamaedorea Pacaya Oerst. Trunk smooth, slender, up to 2 meters in height; leaves pinnate; branches of inflorescence orange-colored; fruit black. Frequent in forest on the slopes of Mt. Cangrejal.



FIG. 5. The manaca palm (*Orbignya Cohune*). The leaves are used commonly for thatching houses.

COCOS L.

Cocos nucifera L. Frequent on the plains near the seashore. Planted for the fruit, which is exported and also used locally for the manufacture of soap, shortening, etc.

DESMONCUS Mart.

Desmoncus chinantlensis Liebm. Stems long and slender, armed with very sharp, needle-like spines; leaves long, pinnate, the uppermost pairs of leaflets transformed into reflexed, spine-like

organs which assist the plant in scrambling in trees and over shrubs; fruit golden yellow. Because of the leaf and stem spines, it is difficult to pass through a thicket of these plants without injury. Occasional in thickets in the foothills back of La Ceiba.

GEONOMA Willd.

Geonoma binervia Oerst. Trunk smooth; leaves pinnate; peduncles red. In dense forest on the slopes of Mt. Cangrejal, at about 200 meters altitude.

ORBIGNYA Mart.

Orbignya Cohune (Mart.) Dahlgren. A fine, large palm common at lower altitudes. The huge leaves are used for thatching houses.

REINHARDTIA Liebm.

Reinhardtia gracilis (Wendl.) Burret. Stems about 1 meter tall; leaves with numerous perforations near the midrib. In dense forest on the slopes of Mt. Cangrejal, at 330 meters altitude.

Reinhardtia rostrata Burret. Stems about 60 cm. tall; leaf blades only about 15 cm. in length, perforated near the midrib; peduncles red; fruit black. Bank of mountain stream on slopes of Mt. Cangrejal.

Reinhardtia simplex (Wendl.) Burret. Stem about 75 cm. tall; leaf blades 15–20 cm. long, without midrib perforations. In a rocky ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

SYNECHANTHUS Wendl.

Synechanthus fibrosus Wendl. Trunk slender, about 3.5 meters tall; leaves pinnate; flowering stalks about 60 cm. long, pendent. In forest on the rocky ridge back of Roma, about 25 kilometers east of La Ceiba.

CYCLANTHACEAE

CARLUDOVICA R. & P.

Carludovica Oerstedii Hemsl. Abundant on stream bank in wet, rocky ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

Carludovica palmata R. & P. Stemless but with petioles up to 2 meters in length. Source of the fiber used in making "Panama"

hats. In deep forest on the bank of a mountain stream, slopes of Mt. Cangrejal, at 300 meters altitude.

CYCLANTHUS Poit.

Cyclanthus bipartitus Poit. Occasional in damp forest on the slopes back of La Ceiba.

ARACEAE

ANTHURIUM Schott

Anthurium aemulum Schott. Spadix purple; spathe greenish. On mossy rock outcropping, ridge back of Roma, about 25 kilometers east of La Ceiba, at 300 meters altitude.

Anthurium concinnum Schott. Spadix pinkish to orange; spathe greenish white; leaves large, ovate-cordate. On a rocky cliff along a mountain stream, slopes of Mt. Cangrejal, back of La Ceiba; also on the rocky ridge back of Roma, about 25 kilometers east of La Ceiba, at 270 meters altitude.

Anthurium consobrinum Schott. Spadix white; spathe green; fruit bright red. On a log in deep, wet forest on the slopes of Mt. Cangrejal, at 360 meters altitude; also on rocks in a deep ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

Anthurium crassinervium (Jacq.) Schott. Stemless, epiphytic; leaves up to 50 cm. long or more, forming a rosette; spadix varying from dark red at the base to green at the tip; spathe dark red. Frequent on trees in semi-arid woodland near Coyoles.

Anthurium fortinense Engler. Stemless; leaves 20 cm. long or more; spadix, spathe, and petioles dull red. On a rocky outcropping, mountain slope near the village of Las Flores, at 330 meters altitude.

Anthurium myosuroides (HBK.) Endl. Spadix and spathe green; berries red. Climbing on trees in forest, foothills back of La Ceiba.

Anthurium scandens (Aubl.) Engler. Spadix and spathe greenish; fruit white. Climbing on trees near the bank of a mountain stream, slopes of Mt. Cangrejal, at 180 meters altitude.

Anthurium scolopendrinum (Ham.) Kunth. Spadix, spathe, and peduncles dull red; berries bright red. On a tree near the Cangrejal River, back of La Ceiba; also on a rock in open forest on mountain slope near the village of Las Flores, at 330 meters altitude.

DIEFFENBACHIA Schott

Dieffenbachia Oerstedii Schott. About 60 cm. tall; leaf blades about 20 cm. long; spathe orange, enclosing the bright red berries. In rich soil, bank of river in deep forest on the lower slopes of Mt. Cangrejal.

Dieffenbachia seguina (L.) Schott. Plants about 1 meter tall; leaf blades much larger than those of the preceding species; spathe greenish, enclosing the bright red fruit. In rich soil on the bank of a stream, lower slopes of Mt. Cangrejal; also on banks of stream in a rocky ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

Both species emit a vile odor and, because of the presence of needle-like crystals in the cells, produce a paralyzing effect on the mouth parts when portions of the plants are chewed.

PHILODENDRON Schott

Philodendron guttiferum Kunth. Epiphytic vine. Spathe green, nearly enclosing the spadix; petioles conspicuously winged. Frequent in forest on the mountain slopes about La Ceiba.

Philodendron oxycardium Schott. Epiphytic vine. Spathe green; leaves ovate-cordate. On tree in the semi-arid woodland near Coyoles.

Philodendron Popenoei Standl. & Steyerf., sp. nov.—Caudex scandens teres 6–8 mm. crassus, internodiis usque 7.5 cm. longis; petiolus 12–22 cm. longus gracilis, vagina insigniter angusta 3–10 cm. infra basin laminae desinente viridi; lamina in sicco fere membranacea ovata vel oblongo-ovata 16–33 cm. longa 13–20 cm. lata, apice breviter apiculata, basi subcordata vel breviter cordata, lobis posticis brevibus late rotundatis, nervis primariis utroque latere ca. 8–9 inter sese 2–3 cm. distantibus angulo lato saepe fere recto abeuntibus teneribus sed conspicuis, secundariis tertiariisque numerosissimis tenerrimis; pedunculus teres crassus 3.5–4 cm. longus; spathae virides 12 cm. longae 2 cm. crassae, tubo angusto, lamina ovato-oblonga acuminata; spadix tenuis anguste cylindroideus apicem versus angustatus longiuscule stipitatus, inflorescentia feminea 3 cm. longa 1 cm. crassa, mascula 5 cm. longa; pistilla columnaria vix ultra 2 mm. longa.—Honduras: Lancetilla Valley, near Tela, Dept. Atlántida, alt. 600 meters or less, 1927–28, *Paul C. Standley* 52625 (type in Herb. Field Mus.); also No. 54390. Hills above Lancetilla, 45 meters, *Yuncker* 4730, 4931. In forest

of foothills back of La Ceiba, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8769.—Guatemala: Near Entre Ríos, Dept. Izabal, 18 meters, *Standley* 72760.

In the *Flora of the Lacantilla Valley* this plant was reported incorrectly as *P. Hoffmannii* Schott, a quite different species. *P. Popenoei* is related actually to *P. guatemalense* Engler, which it much resembles in general appearance. In that, however, the leaves are rounded or obtuse at the base, and the more conspicuous leaf sheath is continued almost to the base of the blade.

The new species is named for Dr. Wilson Popenoe, to whom the authors of this species are greatly indebted for many favors in connection with their field work in Honduras and Guatemala.

Philodendron radiatum Schott. Epiphytic vine. Spathe green; leaves deeply pinnate-lobed. On a tree in ravine in semi-arid upland near the village of Medina.

PISTIA L.

Pistia Stratiotes L. A curious member of this family, with spongy leaves 7 to 10 cm. long, forming rosettes; inflorescence very inconspicuous. On mud banks and floating in shallow pools in swampy areas along the Aguán River.

SPATHIPHYLLUM Schott

Spathiphyllum Friedrichsthali Schott. Terrestrial. Spadix greenish; spathe very large, flat, green. In rich soil in thicket, foothills back of La Ceiba.

SYNGONIUM Schott

Syngonium podophyllum Schott. Epiphytic vine. Spathe red when mature. Leaves divided into narrow segments. Common on the plains and lower foothills about La Ceiba.

BROMELIACEAE

AECHMEA R. & P.

Aechmea bracteata (Swartz) Griseb. Flowers yellow; bracts bright red. A large, conspicuous plant, growing either on the ground or as an epiphyte. Abundant in the semi-arid woodland region near Coyoles.

Aechmea Kienastii E. Morr. Leaves moderately thin, purple at the base; peduncle about 75 cm. long, the flower-bearing part

about 30 cm. long; flower-bearing branches and bracts bright red. On trees in deep forest on the slopes of Mt. Cangrejal, at 300 meters altitude. Not common.

BROMELIA L.

Bromelia sylvestris Willd. Leaves up to 1.5 meters in length, armed with sharp, curved, marginal teeth, some leaves red; flower stalk 30–35 cm. tall; flowers light purple, the immediate bracts red. Frequent in dry soil in the semi-arid woodland regions near Coyoles.

CATOPSIS Griseb.

Catopsis apicroides (Schlecht. & Cham.) Baker. On trees in deep forest on the slopes of Mt. Cangrejal, at 330 meters altitude.

Catopsis Morreniana Mez. On trees in deep, wet forest on the slopes of Mt. Cangrejal, at 360 meters altitude.

PITCAIRNIA L'Hér.

Pitcairnia sp. An unidentified species with leaves up to 1 meter in length and flowering stalk 75 cm. long. Growing among rocks on bank of a stream on the lower slopes of Mt. Cangrejal.

TILLANDSIA L.

Tillandsia Balbisiana Schult. Leaves 30 cm. long or more, very slender, twisted. On trees along the margin of the Aguán River near Coyoles.

Tillandsia brachycaulos Schlecht. Flowers blue, with deep blue stamens; leaves red on the upper surface, green toward the base. A handsome plant. On trees in the semi-arid woodland region near Coyoles.

Tillandsia Caput-Medusae E. Morr. On trees in the foothills back of La Ceiba.

Tillandsia fasciculata Swartz. Leaves 45 cm. long or more, very slender; bracts light tan. On trees in semi-arid woodland region near Coyoles.

Tillandsia festucoides Brongn. Leaves 25 cm. long or more, very slender. On trees in deep forest on the slopes of Mt. Cangrejal, at 300 meters altitude. Frequent.

Tillandsia filifolia Schlecht. & Cham. Plants about 20 cm. tall; leaves slender, filiform. On trees in deep, wet forest on the slopes of Mt. Cangrejal, at 300 meters altitude.

Tillandsia Schiedeana Steud. Plants small, clustered; leaves 10 to 15 cm. long, filiform. On trees in deep, wet forest on the slopes of Mt. Cangrejal, at 330 meters altitude.

Tillandsia usneoides L. Abundant on pines and other trees in open forest on the slopes above the village of Las Flores, at 300 meters altitude.

Tillandsia utriculata L. Leaves 50 cm. long or more, 7 cm. wide or more at the base, constricted above into a slender apex, clustered at the base of the stem to form a large rosette; flowering stalk 1.5 meters tall, loosely and widely branching, the branches rich purple. On trees in forest on the foothills back of La Ceiba.

Tillandsia Valenzuelana A. Rich. Leaves up to 60 cm. or more in length, apically slender; flowers purple; bracts scarlet. A very handsome plant. On trees in the semi-arid woodland region near Coyoles.

VRIESIA Lindl.

Vriesia heliconioides (HBK.) Hook. Bracts bright red, with green tips. On trees in wet forest on the slopes of Mt. Cangrejal.

COMMELINACEAE

CAMPELIA L. Rich.

Campelia Zanonía (L.) HBK. Herb. Flowers white; fruit purple. In the rocky bed of a small mountain stream near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

COMMELINA L.

Commelina elegans HBK. Herb. Flowers pale blue to deep blue. Common in wet areas about La Ceiba; also on sandbars in the Aguán River near Coyoles.

DICHORISANDRA Mikan

Dichorisandra hexandra (Aubl.) Standl. Herb. Stems long and vine-like. Corolla blue in the center, the petals edged with white. Scrambling over shrubs in thicket in a ravine near Puente Alto, about 50 kilometers east of La Ceiba; also on a rocky outcropping on the mountain side above Roma, about 25 kilometers east of La Ceiba.

PONTEDERIACEAE

EICHHORNIA Kunth

Eichhornia azurea (Swartz) Kunth. Floating in a marsh near the seashore, vicinity of La Ceiba.

HETERANTHERA R. & P.

Heteranthera reniformis R. & P. Herb. Flowers white. Creeping in muddy soil along the trail in foothills back of La Ceiba.

PONTEDERIA L.

Pontederia cordata L. Stems 90 cm. or more in height; flowers purplish. In marshy area along the seashore near La Ceiba.

LILIACEAE

DRACAENA L.

Dracaena americana D. Sm. Tree about 6 meters tall; leaves narrow, numerous. In open forest on the rocky mountain slope back of Roma, about 25 kilometers east of La Ceiba, at 240 meters altitude. A conspicuous plant.

SMILACACEAE

SMILAX L.

Smilax Lundellii Killip & Morton. New to Honduras. Woody vine, climbing in trees along the wooded border of the Aguán River, near Coyoles.

Smilax mollis H. & B. Woody vine, climbing in thickets on foothills back of La Ceiba; also in semi-arid woodland near Coyoles.

Smilax munda Killip & Morton. New to Honduras. Woody vine, climbing in thickets near the shore of the Salado River, about 20 kilometers west of La Ceiba.

Smilax spinosa Mill. Woody vine, climbing in thickets on foothills back of La Ceiba.

HAEMODORACEAE

XIPHIDIUM Aubl.

Xiphidium caeruleum Aubl. Herb, about 1 meter tall. Flowers small, white; berries red. In rich soil, wet forest on the slopes of Mt. Cangrejal.

AMARYLLIDACEAE

AGAVE L.

Agave sp. Occasional plants of a sterile, unidentified species were observed in the semi-arid woodland region near Coyoles.

CRINUM L.

Crinum cruentum Ker. Flowers white; stamens with green filaments and orange anthers. A showy and decorative plant. Abundant locally in wet areas on the plains about La Ceiba.

CURCULIGO Gaertn.

Curculigo scorzoneraefolia (Lam.) Baker. Low herb with yellow flowers. In grass in open, forested area on mountain slopes near Las Flores, at 330 meters altitude.

HYPOXIS L.

Hypoxis decumbens L. Low herb with yellow flowers. In grass in open, forested area on mountain slopes near Las Flores, at 330 meters altitude, associated with the preceding species.

DIOSCOREACEAE

DIOSCOREA L.

Dioscorea Koepperi Standl., sp. nov.—Gracillima volubilis ubique glaberrima, caulibus teretibus ca. 1 mm. crassis, internodiis valde elongatis; folia mediocria petiolata tenuia in sicco olivacea, petiolo gracillimo ca. 2 cm. longo; lamina anguste lanceolato-oblonga ca. 11 cm. longa atque 3 cm. lata longiacuminata, basi profunde (ca. 1 cm.) cordata, sinu lato, lobis posticis obtusis, supra sublucida, venis prominulis, subtus lucida, trinervia, nervis 2 utroque latere vulgo supra basin nascentibus, venis laxae reticulatis prominentibus; racemi masculi axillares singuli plerumque 15–25 cm. longi, rhachi flexuosa angulata, spiculis numerosis solitariis pauci- vel multifloris usque 1 cm. longis sed vulgo brevioribus, bracteis viridescentibus triangulari-ovatis floribus brevioribus acutis carinatis, floribus dense aggregatis sessilibus; perianthii segmenta ovalia pallida tenuia subhyalina obtusa fere 1.5 mm. longa; stamina 6.—Honduras: Climbing in thicket, near Río Danto, lower slopes of Mt. Cangrejal, near La Ceiba, Dept. Atlántida, July 16, 1938, T. G. Yuncker, J. M. Koepper & K. A. Wagner 8482 (type in Herb. Field Mus.).

The leaves are distinctive in form, being long and narrow, with almost parallel sides, the basal lobes short, directed downward, and rounded-triangular in shape in the well developed leaves.

Dioscorea macrostachya Benth. Herbaceous vine. Fruit 2.5 cm. long or more, abundant, in large clusters. Climbing high in trees, edge of forest on the foothills back of La Ceiba.

MUSACEAE

HELICONIA L.

Heliconia Bihai L. Inflorescence erect; bracts yellow or somewhat reddish, short and broad. On the bank of the Salado River, 20 kilometers west of La Ceiba, and elsewhere in low, wet areas.

Heliconia crassa Griggs. Stems 1 to 1.5 meters tall, leafy to the top; leaves relatively small; corolla yellowish; bracts few, bright red or somewhat orange; berries blue. In wet thicket on the lower slopes of Mt. Cangrejal; also in a rocky ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

Heliconia elegans Peters. Plants about 3.5 meters tall. Inflorescence dense, 30 cm. long or more; bracts red, short and broad, strongly compressed, equitant and two-ranked. On slopes near Puente Alto, about 50 kilometers east of La Ceiba, at 270 meters.

Heliconia latispatha Benth. Plants 2 meters tall. Inflorescence erect; bracts yellow, long and slender, becoming shorter toward the summit. Frequent in low, wet areas about La Ceiba.

Heliconia librata Griggs. About 2 meters tall. Bracts yellow. In rich soil on mountain slopes near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

Heliconia revoluta Griggs? About 2.5 meters tall. Inflorescence pendent; flowers yellow; bracts bright red, spreading, long and slender. The handsomest species seen. In a rocky ravine on slopes near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude; also along the Cangrejal River, back of La Ceiba.

ZINGIBERACEAE

COSTUS L.

Costus sanguineus D. Sm. Plants about 2 meters tall. Spikes terete, up to 30 cm. or more in length; bracts closely imbricate, reddish. Common in thickets about La Ceiba.

HEDYCHIUM Koen.

Hedychium coronarium Koen. Herb, about 1 meter tall; flowers white. In wet area at edge of thicket, plains west of La Ceiba. Naturalized(?).

RENEALMIA L. f.

Renelalmia aromatica (Aubl.) Griseb. Herbaceous, up to 2 meters in height; inflorescence basal; flowers and fruit red. Fruit said to be edible. In low, wet soil on the banks of the Salado River, about 20 kilometers west of La Ceiba; also on the bank of a stream near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

CANNACEAE**CANNA** L.

Canna indica L. Herb, about 1 meter tall or less; flowers bright red. In swampy area about La Ceiba.

MARANTACEAE**CALATHEA** Meyer

Calathea altissima Koern. Plants herbaceous, about 2 meters tall. Inflorescence subglobose; flowers cream; bracts straw-colored. In thickets on the foothills back of La Ceiba.

Calathea insignis Peters. Plants 2 to 2.5 meters tall. Spikes up to 15 cm. long, strongly compressed; bracts broad, two-ranked, equitant, straw-colored or somewhat greenish. In a rocky ravine on the slopes near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

Calathea lutea (Aubl.) Mey. Plants about 1 meter tall. Spikes not compressed; bracts broad, bronze-red, equitant. In thicket at the edge of the Salado River, about 20 kilometers west of La Ceiba.

Calathea macrosepala Schum. Herb about 1 meter tall. Flowers creamy white. In rich soil, thickets on the lower slopes of Mt. Cangrejal.

Calathea micans (Math.) Koern. Herb about 45 cm. tall; inflorescence mostly less than 2.5 cm. long. In rich, wet soil, edge of stream in foothills back of La Ceiba.

MARANTA L.

Maranta arundinacea L. Herb, up to 2.5 meters tall. Flowers white. In thicket on bank of stream, slopes near Las Flores, at 300

meters altitude; also on bank of river in foothills back of La Ceiba. Sometimes cultivated for the roots, which are a source of starch.

MYROSMA L. f.

Myrosma guapilensis D. Sm. Herb, about 1 meter tall. In moist thicket on foothills back of La Ceiba.

PLEIOSTACHYA Schum.

Pleiostachya pruinosa (Regel) Schum. Herb, about 1 meter tall. In thickets at edge of forest on the lower slopes of Mt. Cangrejal.

THALIA L.

Thalia geniculata L. Herb, about 3 meters tall. Leaf blades up to 1 meter long; inflorescence loose; peduncles zigzag; flowers blue with a yellow throat. Frequent in low, marshy areas about La Ceiba.

ORCHIDACEAE

CAMPYLOCENTRUM Benth.

Campylocentrum micranthum (Lindl.) Rolfe. Flowers small, white. On trees in forest on the slopes of Mt. Cangrejal, at 150 meters altitude.

CRYPTARRHENA R. Br.

Cryptarrhena lunata R. Br. On branches of trees in wet forest on the slopes of Mt. Cangrejal, at 300 meters altitude.

DICHAEA L.

Dichaea muricata Lindl. Epiphytic. Stems long, pendent from tree branches; flowers yellowish orange. In deep forest on the slopes of Mt. Cangrejal, at 300 meters altitude.

EPIDENDRUM L.

Epidendrum alatum Batem. Leaves about 45 cm. long; inflorescence about 1 meter long or less, loosely branching; flowers brownish yellow; lip with brown lines. A handsome plant. On trees in open forest in semi-arid upland near the village of Las Flores, at 330 meters altitude.

Epidendrum cochleatum L. Epiphytic. Lip greenish purple with yellow stripes, the other perianth parts yellowish green. On

trees in deep forest on rocky ridge back of Roma, about 25 kilometers east of La Ceiba, at 360 meters altitude.

Epidendrum imatophyllum Lindl. Flowers lavender. On trees in forest on the lower slopes of Mt. Cangrejal.

Epidendrum nocturnum Jacq. On rocks in open pine forest on the slope above the village of Las Flores, at 300 meters altitude.

Epidendrum paleaceum (Lindl.) Rehb. f. With only one leaf on a stem. On trees in deep forest on the slopes of Mt. Cangrejal, at 300 meters altitude.

Epidendrum xipheres Rehb. f. Epiphytic, with pseudobulbs. Leaves solitary on each stem; flowers yellow; fruit slender, densely covered with short, spinose projections. Abundant in semi-arid woodland region near Coyoles.

LEPANTHES Swartz

Lepanthes inaequiloba Ames & Schweinf. A small epiphyte. Calyx yellowish green; corolla yellowish orange. On trees in deep forest on the slopes of Mt. Cangrejal, at 330 meters altitude.

MAXILLARIA R. & P.

Maxillaria uncata Lindl. A small epiphyte with linear leaves and purplish flowers. On trees in deep forest on the slopes of Mt. Cangrejal, at 240 meters altitude.

ONCIDIUM Swartz

Oncidium Lindenii Brongn. Lip dark red; throat yellowish. On trees in open forest on mountain slope near Las Flores, at 330 meters altitude.

ORNITHOCEPHALUS Hook.

Ornithocephalus bicornis Lindl.(?). Small epiphyte with equitant leaves spreading fan-wise. On branches of trees on bank of stream on slopes of Mt. Cangrejal.

PLEUROTHALLIS R. Br.

Pleurothallis Brighamii S. Wats. Small epiphyte. Outer lobes of flower yellowish green striped with maroon; throat maroon. On branches of trees in deep forest on the slopes of Mt. Cangrejal, at 330 meters altitude.

POLYSTACHYA Hook.

Polystachya minor Fawc. & Rendle. On mossy rocks, margin of stream on the slopes of Mt. Cangrejal, at 330 meters altitude.

SCAPHOSEPALUM Pfitz.

Scaphosepalum Standleyi Ames. A small epiphyte. Flowers purplish green. On branches of trees in deep forest on the slopes of Mt. Cangrejal, at 330 meters altitude.

SCHOMBURGKIA Lindl.

Schomburgkia tibicinis Batem. A large, handsome epiphyte. Inflorescence nearly 1 meter tall, branching; floral parts burnt-orange; lip whitish yellow. On trees at edge of the Salado River, about 20 kilometers west of La Ceiba.

STELIS Swartz

Stelis ciliaris Lindl. A small epiphyte with maroon flowers. On branches of trees in deep forest on the slopes of Mt. Cangrejal, at 240 meters altitude.

Stelis purpurascens Rich. & Gal. On trees in deep forest on the slopes of Mt. Cangrejal, at 270 meters altitude.

VANILLA Swartz

Vanilla Pfaviana Rehb. f.(?). Climbing on trees in thickets on the banks of the Salado River, about 20 kilometers west of La Ceiba.

PIPERACEAE

PEPEROMIA R. & P.

Peperomia cangrejalana Trelease, sp. nov.—Herba modica late repens terrestris, caulibus erectis foliosis, 2–3 mm. crassis; folia alterna elliptica vel oblanceolato-elliptica vulgo emarginata, basi acuta, 5–7 cm. longa 2.5–3.5 cm. lata, pinnatinervia, in sicco chartacea, petiolo ca. 2 cm. longo; spicae terminales vel sympodiales solitariae ramulum 1-bracteatum 15 mm. longum terminantes, in statu juvenili graciles vix 40 mm. longae, pedunculo 5–10 mm. longo.—Honduras: Lower slopes of Mt. Cangrejal, near La Ceiba, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8765 (type in herb. Univ. Illinois).

Peperomia dantoana Trelease, sp. nov.—Herba majuscula late repens plus minusve divaricato-furcata glabra truncicola, caule 3 mm. crasso; folia late elliptica ad sublanceolata acute acuminata, basi subcordulato-acuta, 5–7 cm. longa 3–3.5 cm. lata, in sicco opaca, coriacea, 1-nervia, nervis lateralibus obsoletis, petiolo 1 cm. longo;

spicae geminatae ramulum brevissimum terminalem terminantes, filiformes 60–70 mm. longae, pedunculo 5 mm. longo.—Honduras: Río Danto, Mt. Cangrejal, near La Ceiba, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8499 (type in herb. Univ. Illinois).

Peperomia floresensis Trelease, sp. nov.—Herba patens arboricola, caule transiente minute pubescente 3–4 mm. crasso; folia alterna late lanceolata vel subelliptico-lanceolata sensim acuto-acuminata, basi acuta, 9–11 cm. longa 3–4.5 cm. lata, pinnatinervia, supra laxe araneosa, petiolo 2.5–5.5 cm. longo; spicae 1–2 ramulum brevem terminalem terminantes 70–100 mm. longae 1–5 mm. crassae, pedunculo 15 mm. longo; baccae oblongae oblique acuto-scutellatae, stigmatate centrali.—Honduras: Las Flores, Dept. Yoro, alt. 270 meters, *Yuncker, Koepper & Wagner* 8149 (type in herb. Univ. Illinois).

Peperomia Koepperi Trelease, sp. nov.—Herba parva repenti-patens arboricola, caule filiformi glabrato; folia alterna elliptico-subobovata obtusa, basi acuta, ca. 6 mm. longa atque 3 mm. lata, in sicco tenuia sed opaca et vix obvie nervata glabra, petiolo 1–3 mm. longo; spicae terminales vix 10 mm. longae atque 1 mm. crassae, pedunculo brevissimo.—Honduras: Mt. Cangrejal, Dept. Atlántida, alt. 300 meters, *Yuncker, Koepper & Wagner* 8508 (type in herb. Univ. Illinois). Also, at a lower elevation, near Río Danto, No. 8380.

Peperomia lenticularis Dahlst. Stems slender; leaves orbicular, less than 1 cm. broad. Creeping on trees in forest, foothills back of La Ceiba; also on trees in forest near Las Flores, at 180 meters altitude.

Peperomia rio-cangrejalensis Trelease, sp. nov.—Herba magna dependens glabra arboricola, caule 2–3 mm. crasso; folia alterna elliptica subcaudata, basi subacuta, 10 cm. longa 4 cm. lata, inferne obscure submultiplinervia, petiolo 1–2 cm. longo; spicae singulae vel geminatae ramulum brevem terminalem terminantes 80–90 mm. longae 3 mm. crassae, pedunculo gracili 20 mm. longo; baccae oblongae acute scutulatae, stigmatate centrali.—Honduras: Río Cangrejal, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8018 (type in herb. Univ. Illinois). Also No. 8794.

Peperomia romaensis Trelease, sp. nov.—Herba majuscula repenti-erecta simplex glabra, caule 2–4 mm. crasso; folia alterna rotundato-obovata obtusa, basi cuneata, 9–11 cm. longa 6–7 cm. lata tenuiter pinnatinervia, in sicco opaca coriacea subrevoluta, petiolo 2 cm. longo; spicae geminatae ramulum terminalem bibrac-

teatum terminantes graciles 150 mm. longae, pedunculo roseo gracili 3 mm. longo.—Honduras: Roma railroad siding, 25 km. east of La Ceiba, Dept. Atlántida, alt. 360 meters, *Yuncker, Koepper & Wagner* 8585 (type in herb. Univ. Illinois).

Peperomia rubefacta Trelease, var. ***cangrejalana*** Trelease, var. nov.—Quam species minus obvie glanduloso-granulosa, caule valde sulcato-alato.—Honduras: Mt. Cangrejal, Dept. Atlántida, alt. 330 meters, *Yuncker, Koepper & Wagner* 8737 (type in herb. Univ. Illinois). Also, at 360 meters, No. 8775.

Peperomia rubefacta Trelease, var. ***reducta*** Trelease, var. nov.—Planta minor, caule graciliore, foliis angustius lanceolatis vix 3–4 cm. longis atque 1 cm. latis.—Honduras: Mt. Cangrejal, Dept. Atlántida, alt. 300–330 meters, *Yuncker, Koepper & Wagner* 8736 (type in herb. Univ. Illinois). Also Nos. 8735 and 8510.

Peperomia tremulaeformis Trelease, sp. nov.—Herba late repens, caulibus gracilibus; folia alterna rotundato-ovata vel triangulari-ovata acuminata, basi subtruncata vel subacuta, 2–3 cm. longa 1.5 cm. lata, trinervia vel saepius 5-nervia, supra aliquot tomentulosa atque fuscescens, subtus flavescens atque glabra, petiolo filiformi 1–2 cm. longo; spicae 15–20 mm. longae 1 mm. crassae, pedunculo filiformi ca. 15 mm. longo; baccae oblongae rostratae, stigmatibus anteriori ad basin rostri inserto.—Honduras: Río Danto, Mt. Cangrejal, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8722 (type in herb. Univ. Illinois).

Peperomia Wagneri Trelease, sp. nov.—Herba majuscula caespitosa glabra epiphytica, caule 5 mm. crasso in sicco anguloso lucido-ochraceo; folia inferne opposita superne ternata rhombico-elliptica vel subobovata obtusa vel saepius obtuse longiacuminata, basi acuta, 3–4 cm. longa 2–3 cm. lata, vix plus quam uninervia, in sicco coriacea, petiolo 5–10 mm. longo; spicae terminales 80 mm. longae 2 mm. crassae, pedunculo gracili 2 cm. longo; baccae rotundato-ovoideae pseudocupula auctae acutatae, stigmatibus apicali.—Honduras: Coyoles, Dept. Yoro, *Yuncker, Koepper & Wagner* 8127 (type in herb. Univ. Illinois). Also No. 8055.

PIPER L.

Piper atrichopus Trelease, var. ***arborescens*** Trelease, var. nov.—Arbustula(?) glabra 3-metralis; folia plerumque basi inaequilateralia, petiolo gracili ca. 1 cm. longo; spicae usque 65 mm. longae atque 3 mm. crassae, pedunculo 5 mm. longo.—Honduras: Roma siding, about 25 km. east of La Ceiba, Dept. Atlántida, alt.

300 meters, *Yuncker, Koepper & Wagner* 8578 (type in herb. Univ. Illinois).

Piper auritilaminum Trelease, sp. nov.—Arborescens trimetralis, trunco 5 cm. diam., nervis venisque foliorum juvenilium minute puberulis exceptis glabra; folia elliptica subacuta, basi oblique auriculata, latere longiore petiolo longiore, 4 cm. longa 2.3 cm. lata e 2 tertiis inferioribus submultiplinervia, petiolo 6+2 cm. longo alato; spicae valde curvatae ca. 150 mm. longae 3 mm. crassae,



FIG. 6. A large-leaved Piper (*Piper auritum*).

pedunculo 4 cm. longo.—Honduras: Lower slopes of Mt. Cangrejal, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8263 (type in herb. Univ. Illinois).

Piper auritilimbum Trelease, sp. nov.—Arbuscula 5-metralis foliis saltem in statu juvenili minute pubescentibus superne sparse pubescentibus exceptis glabra, foliorum nervis subtus hirtello-pubescentibus; folia elliptico-subovata valde acuta, basi oblique auriculata, ca. 30 cm. longa atque 15 cm. lata, e tertio superiore submultiplinervia, petiolo 4+2 cm. longo alato; spicae rectae usque ad 220 mm. longae atque 5 mm. crassae, pedunculo 6 cm. longo.—Honduras: Río Danto, Mt. Cangrejal, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8763 (type in herb. Univ. Illinois).

Piper calvescens Trelease, var. **aguanum** Trelease, var. nov.—Subarborescens sed vix trimetralis; folia rotundata vel rotundato-elliptica, inferiora 10–15 cm. longa 9 cm. lata, superiora lanceolata 4–5 cm. lata; spicae 100 mm. longae.—Honduras: Río Aguán, below Coyoles, Dept. Yoro, *Yuncker, Koepper & Wagner* 8124 (type in herb. Univ. Illinois).

Piper calvescens Trelease var. **cangrejalense** Trelease, var. nov.—Arbuscula 3–4-metralis, petiolis nervisque foliorum juvenilium sparse pubescentibus exceptis glabra; folia rotundato-elliptica acute acuminata, basi obtusa vel subobtusa 10 cm. longa 6 cm. lata 5–7-nervia; spicae 50 mm. longae 5 mm. crassae, pedunculo 5 mm. longo sparse pubescente.—Honduras: Mt. Cangrejal, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8464 (type in herb. Univ. Illinois).

Piper coyolesense Trelease, sp. nov.—Subarborescens vix 3 m. alta ubique molliter tomentulosa, internodiis superioribus modice brevibus crassisque; folia subrhombea aliquanto acuminata, basi inaequaliter obtusa, 17 cm. longa 9 cm. lata e medio inferiore pinnatinervia, nervis 5×6 venis transversis connexis, petiolo ca. 10 mm. longo; spicae ca. 70 mm. longae atque 3 mm. crassae, pedunculo vix 5 mm. longo.—Honduras: Near Las Flores, Río Aguán, Dept. Yoro, alt. 270 meters, *Yuncker, Koepper & Wagner* 8147 (type in herb. Univ. Illinois).

Piper crassicaule Trelease, sp. nov.—Arbor glabra 7-metralis, trunco 12 cm. diam., internodiis brevibus graciliusculis; folia elliptica vel suboblunga acuminata, basi inaequilateraliter acuta, latere altero ad basin petioli decurrente, 16–18 cm. longa 5–7 cm. lata ubique pinnatinervia, in sicco papyracea caerulescentia, petiolo 1.5–2 cm. longo latere longiore ad basin alato, basi laminae appendice 2–3 mm. longo aucta; spicae 125 mm. longae 2 mm. crassae, pedunculo 5–10 mm. longo.—Honduras: Ridge near Roma railroad siding, about 25 km. east of La Ceiba, Dept. Atlántida, alt. 240 meters, *Yuncker, Koepper & Wagner* 8572 (type in herb. Univ. Illinois).

Piper elasmophyllum Trelease, sp. nov.—Arborescens trimetralis, foliis eis *P. dilatati* similibus, internodiis gracilibus cito elongatis transiente molliter pubescentibus; folia plus minusve rhombico-subovato-elliptica subacuminata, basi inaequaliter cordulata 13–16 cm. longa 7–9 cm. lata, e medio inferiore pinnatinervia, nervis 5×6 , transiente molliter pubescentia, nervis subtus similiter pubescentibus, petiolo 10–20 mm. longo; spicae 40 mm. longae 2 mm. crassae, pedunculo 5 mm. longo, bracteis triangulari-subpeltatis

pubescentibus; baccae obtuse triquetrae.—Honduras: Lower slopes of Mt. Cangrejal, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8461 (type in herb. Univ. Illinois).

Piper evulsipilosum Trelease, sp. nov.—Frutex vix trimetralis, internodiis molliter pilosis; folia elliptica subacuminata, basi aliquanto inaequaliter obtusa, 18–20 cm. longa 7–9.5 cm. lata, e 2 tertiis inferioribus pinnatinervia, nervis ca. 4×2 , supra lucida intense viridia, subtus pallida opaca, nervis venisque hirtellis, petiolo 5–10 mm. longo alato plus minusve piloso; spicae 60 mm. longae 5 mm. crassae apiculatae, pedunculo 10 mm. longo, bracteis crescenticis; baccae rotundatae brunneo-velutinae.—Honduras: La Ceiba, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8015 (type in herb. Univ. Illinois).

Piper gracillimum Trelease. Shrub up to 2.5 meters tall; leaves comparatively small, 3-nerved, with a long, slender apex. In rich soil, shady ravines, semi-arid region near Coyoles.

Piper gracillimum Trelease, var. *dantoense* Trelease, var. nov.—Arbuscula glabra trimetralis, ramis gracilibus; folia lanceolata apice subcaudata, basi acuta, 9 cm. longa 4 cm. lata trinervia, petiolo fere nullo; spicae ca. 60 mm. longae atque 3 mm. crassae, pedunculo 10 mm. longo; baccae oblongae.—Honduras: Río Danto, Mt. Cangrejal, Dept. Atlántida, alt. 180 meters, *Yuncker, Koepper & Wagner* 8485 (type in herb. Univ. Illinois).

Piper Koepperi Trelease, sp. nov.—Subarborescens ca. trimetralis glabra vel folia majora subtus in basibus laminarum pubescentia; folia lanceolato-ovata acuta basi gibboso-subcordata 8.5–25 cm. longa 4–9 cm. lata 5-nervia, venulis transversis conspicuis, in sicco lucida papyracea, petiolo 1–2 cm. longo; spicae in statu fructifero 60 mm. longae 5 mm. crassae, pedunculo 10 mm. longo; bractee crescenticae; baccae ellipsoideae cum rhachi elongatae, stigmatibus parvis sessilibus.—Honduras: Near Medina, Aguán Valley, Dept. Yoro, alt. 195 meters, *Yuncker, Koepper & Wagner* 8631 (type in herb. Univ. Illinois). Also near La Ceiba, Dept. Atlántida, No. 8014.

Piper meritum Trelease, sp. nov.—Subarborescens ca. 3 m. alta, internodiis brevibus modice crassis transiente molliter pubescentibus; folia subovato-elliptica acute acuminata, basi insigniter inaequaliter cordulata, 15–16 cm. longa 8 cm. lata, e medio inferiore pinnatinervia, nervis 5×6 pallidis substrigosis, petiolo vix 10 mm. longo lobo basali longiore folii occulto; spicae plus minusve curvatae 100 mm. longae 3 mm. crassae apiculatae, pedunculo 10 mm. longo;

baccae parvae subcubicae.—Honduras: La Ceiba, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8363 (type in herb. Univ. Illinois).

Piper multinervium Mart. & Gal. Shrub or small tree, up to 3.5 meters in height; leaves rough. Common in thickets about the plains and on the lower mountain slopes, vicinity of La Ceiba.

Piper puente-altoanum Trelease, sp. nov.—Arbuscula 5-metralis, internodiis brevibus graciliusculis aliquanto ut petiolus pedunculusque scabridis; folia oblongo-subelliptica acuminata, basi inaequaliter obtusa, 18–20 cm. longa 6 cm. lata e medio inferiore pinnatinervia, nervis ca. 6×2 , supra granuloso-scabrida, subtus saltem in statu juvenili ad nervos strigosa, petiolo vix 2+3 mm. longo; spicae vix 50 mm. longae atque 2 mm. crassae, pedunculo vix 5 mm. longo.—Honduras: Puente Alto, on the railroad about 50 km. east of La Ceiba, Dept. Atlántida, alt. 240 meters, *Yuncker, Koepper & Wagner* 8549 (type in herb. Univ. Illinois).

Piper sagax Trelease, sp. nov.—Frutex 2-metralis petiolis atque nervis subtus evanescente puberulus; folia late elliptica aliquanto acuminata, basi rotundata latere altero breviora, ca. 15–18 cm. longa atque 9 cm. lata, e 2 tertiis inferioribus pinnatinervia, nervis 4×5 , supra lucida intense viridia, petiolo gracili 10+2 mm. longo exalato; spicae 40 mm. longae 3 mm. crassae, pedunculo 10 mm. longo.—Honduras: Coyoles, Dept. Yoro, *Yuncker, Koepper & Wagner* 8030 (type in herb. Univ. Illinois).

Piper subaequilaterum Trelease, sp. nov.—Arborescens vix trimetralis tomentulosa, internodiis primo modice brevibus crassisque glabrescentibus; folia subrhombico-elliptica acuta, basi fere aequilateraliter obtusa, 14 cm. longa 8 cm. lata e medio inferiore pinnatinervia, nervis 5×2 , supra intensius viridia, petiolo 10–15 mm. longo; spicae 60 mm. longae 3 mm. crassae, pedunculo 5 mm. longo.—Honduras: Roma siding, about 25 km. east of La Ceiba, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8565 (type in herb. Univ. Illinois).

Piper tuberculatum Jacq. Shrub, sometimes somewhat scandent; petioles with a characteristic horn-like projection at the base of the leaf blade. In ravine of a dry stream near Coyoles.

Piper tuberculatum var. **cangrejalense** Trelease, var. nov.—Subscandens glabra, costis foliorum pubescentibus, petiolis brevibus plus minusve verrucosis; lamina folii 12–13 cm. longa 6–7 cm. lata.—Honduras: Lower slopes of Mt. Cangrejal, Dept. Atlántida, *Yuncker, Koepper & Wagner* 8204 (type in herb. Univ. Illinois).

Piper tumidipedunculum Trelease, sp. nov.—Arborescens ca. trimetralis, ramis nodosis, internodiis brevibus, petiolis atque ramis infra insertionem petioli aliquanto crispo-pilosis exceptis glabra; folia lanceolata vel oblanceolata subcaudata, basi aliquanto inaequaliter cordulata, 12–19 cm. longa 4–6 cm. lata, e 2 tertiis inferioribus pinnatinervia, nervis ca. 4×2 , lucida, chartacea, petiolo 5–10 mm. longo; spicae 75 mm. longae 3 mm. crassae, pedunculo carnosio tumido 10 mm. longo; bracteae subcrescenticae; baccae subcrateriformi-depressae.—Honduras: Las Flores, near Coyoles, Dept. Yoro, alt. 300 meters, *Yuncker, Koepper & Wagner* 8151 (type in herb. Univ. Illinois).

Piper uncatum Trelease. Shrub or small tree about 2 meters tall. In thickets on the lower slopes of Mt. Cangrejal.

Piper variabile C. DC. var. **obtentum** Trelease, var. nov.—Arbuscula trimetralis cito glabrescens, internodiis floriferis brevibus graciliusculis; folia late subovata subacuta, basi fere aequaliter truncato-rotundata, 18 cm. longa 12 cm. lata, e 2 tertiis inferioribus multiplinervia, nervis ca. 5×2 , subtus prope basin transiente araneosa, petiolo 3–5 cm. longo exalato; spicae 70 mm. longae 3 mm. crassae, pedunculo 15 mm. longo; baccae minutae.—Honduras: Mt. Cangrejal, Dept. Atlántida, alt. 150 meters, *Yuncker, Koepper & Wagner* 8495 (type in herb. Univ. Illinois).

POTHOMORPHE Miquel

Pothomorphe peltata (L.) Miq. var. **hypoleuca** Trelease. Herbaceous, about 1 meter tall; spikes white, numerous. In ballast along the railroad right-of-way near La Ceiba.

SALICACEAE

SALIX L.

Salix chilensis Molina. Tree up to 15 or 18 meters tall and nearly one meter in diameter. Common in wet areas and along banks of streams on the plains about La Ceiba.

FAGACEAE

QUERCUS L.

Quercus aguana Trelease, sp. nov.—*Leucobalanos-Macrophyllae*. Ramuli crassiusculi 4 mm. crassi aliquanto striati, primo dense ferrugineo-tomentosi, serius glabrescentes atque lucidi, pallido-

lenticellati; folia ad apicem rami aggregata decidua elliptico-subobovata obtusa vel emarginato-rotundata, basi breviter cordata, undulato-crenata, paullo impresso-reticulata, supra costa ferrugineo-tomentosa excepta viridia atque glabrescentia, subtus dense pallido-tomentulosa, 16–18 cm. longa 8–9 cm. lata, venis ca. 15×2 parum furcatis vix arcuatis, petiolo vix 10 mm. longo; fructus annuus ut videtur apice pedunculi tomentosi 2 cm. longi singulus; cupulae immaturae squamae adpressae cinereo-pubescentes.—Honduras: Las Flores, near Coyoles, Dept. Yoro, alt. 270 meters, *Yuncker, Koepper & Wagner* 8180 (type in herb. Univ. Illinois). A tree 10–12 meters tall and 50 cm. in diameter.

Quercus oleoides Cham. & Schlecht. Tree about 15 meters tall and 60 cm. in diameter, the bark rough. In open forest area at about 270 meters altitude near the village of Las Flores.

Quercus yoroensis Trelease, sp. nov.—*Erythrobalanos-Linguae-foliae*. Ramuli crassiusculi 3 mm. crassi aliquanto striati annotini ferrugineo-tomentosi, serius grisei vix lenticellati; gemmae rotundatae vel ellipsoideae glabratae lucido-brunneae 5 mm. longae 2 mm. latae; folia elliptica obtusa, basi rotundata, 9–15 cm. longa 4–6 cm. lata plus minusve revoluta, chartacea, sublucida, costa utrinque ferrugineo-tomentulosa, nervis ca. 12×2 supra impressis subtus salientibus furcatis arcuatis, petiolo 5 mm. longo tomentuloso; fructus ut videtur biennis pedunculum 5 cm. longum terminans primo depresso-globosus, squamis adpressis lucidis glabratis obtusis.—Honduras: Las Flores, Aguán Valley, Dept. Yoro, alt. 330 meters, *Yuncker, Koepper & Wagner* 8181 (type in herb. Univ. Illinois). A tree 10 meters tall and 40 cm. in diameter.

Quercus yoroensis var. *aguanana* Trelease, var. nov.—E *Q. yoroensi* ramulis gracilioribus griseo-tomentulosis differt; folia magis lanceolato-oblonga usque plus minusve rhombico-subovata fere glabra utrinque lucida olivacea; fructus singuli vel geminati pedunculum brevem terminantes, squamis cupulae opacioribus atque densius pubescentibus.—Honduras: Growing with the species, at 300 meters altitude, *Yuncker, Koepper & Wagner* 8185 (type in herb. Univ. Illinois).

ULMACEAE

CELTIS L.

Celtis iguanaea (Jacq.) Sarg. Small tree about 5 meters tall. In semi-arid forest region near Coyoles.

TREMA Lour.

Trema micrantha (L.) Blume. Tree about 7.5 meters tall; flowers small, greenish white; fruit red. In forest on the lower slopes of Mt. Cangrejal.

MORACEAE**ARTOCARPUS** Forst.

Artocarpus communis Forst. Cultivated. Occasionally found at some distance from dwellings as an escape.

CASTILLA Cerv.

Castilla elastica Cerv. Tree up to 12 meters tall and 30 to 45 cm. in diameter; bark smooth; latex white and very abundant. Common on the plains about La Ceiba.

CECROPIA L.

Cecropia asperrima Pittier. Tree about 8 to 10 meters tall. Common in cut-over areas and edge of forest on the plains and lower foothills about La Ceiba.

DORSTENIA L.

Dorstenia choconiana Wats. var. **integrifolia** D. Sm. In deep forest on the foothills back of La Ceiba.

Dorstenia Contrajerva L. var. **Houstoni** (L.) Bureau. In rich soil, wet ravine on slope near Puente Alto, about 50 kilometers east of La Ceiba, at about 240 meters altitude.

FICUS L.

Ficus glabrata HBK. Fine, spreading tree about 15 meters tall, the trunk about 1.5 meters in diameter. On the banks of a stream, lower slopes of Mt. Cangrejal, at 150 meters altitude.

Ficus Hemsleyana Standl. Tree about 12 meters tall. In forest on the lower slopes of Mt. Cangrejal.

Ficus involuta (Liebm.) Miq. Tree about 15 meters tall and 75 cm. in diameter. In forest, foothills back of La Ceiba.

URTICACEAE**MYRIOCARPA** Benth.

Myriocarpa obovata D. Sm. Tree about 5 meters tall; spikes slender, 25 to 30 cm. long. On the bank of the Danto River, lower slopes of Mt. Cangrejal back of La Ceiba.

PILEA Lindl.

Pilea pubescens Liebm. Small herb 5 to 7 cm. tall. On mossy rocks, stream bank on the slopes of Mt. Cangrejal.

POUZOLZIA Gaud.

Pouzolzia obliqua Gaud. Shrub, about 1 meter tall. In ravines in semi-arid upland near the village of Medina, at 180 meters altitude.

URERA Gaud.

Urera alceaefolia Gaud. Small tree about 4.5 meters tall; flowers small, green. In forest on the slopes of Mt. Cangrejal, at 360 meters altitude.

Urera elata (Swartz) Griseb. Small tree about 6 meters tall, with stinging hairs; flowers greenish white. In wet forest on slopes of Mt. Cangrejal, at 150 meters altitude.

LORANTHACEAE

ORYCTANTHUS Eichl.

Oryctanthus cordifolius (Presl) Eichl. Parasitic. Leaves opposite, ovate, sessile; spikes and berries red. Frequent on trees on the plains and in the forest on the lower slopes about La Ceiba.

PHORADENDRON Nutt.

Phoradendron piperoides (HBK.) Trelease. Leaves elliptic and acute. Parasitic on a large fig tree on the bank of the Cangrejal River in the foothills back of La Ceiba.

Phoradendron robustissimum Eichl. Parasitic. Leaves oblong, obtuse; spikes greenish yellow. Frequent on trees in semi-arid woodland near Coyoles.

Phoradendron venezuelense Trelease. Parasitic. Leaves 3–4 cm. long, oblong-spatulate; spikes green. On trees in semi-arid woodland near Coyoles.

PTHIRUSA Mart.

Phthirusa pyrifolia (HBK.) Eichl. Parasitic. Stems slender; leaves oblong or ovate-oblong, mucronate. Frequent on trees in forest on the lower slopes of Mt. Cangrejal.

PSITTACANTHUS Mart.

Psittacanthus calyculatus (DC.) Don. Parasitic. Stems stout and angled; leaves mostly falcate; flowers and berries red. On tree near the Cangrejal River, foothills back of La Ceiba.

STRUTHANTHUS Mart.

Struthanthus Deppeanus (S. & C.) Blume. Parasitic. Stems twining; leaves petiolate, elliptic, with acute base and attenuate-acuminate apex. On trees in the forest, foothills back of La Ceiba.

Struthanthus orbicularis (HBK.) Blume. Parasitic. Stems somewhat twining; leaves obtuse; fruit dark red. On trees near the bank of the Cangrejal River, foothills back of La Ceiba.

Struthanthus phaneroneurus Standl., sp. nov.—Frutex parasiticus omnino glaber, ramis vetustioribus teretibus griseis rimosis 4 mm. crassis, junioribus ochraceis vel brunnescentibus, internodiis brevibus; folia in sicco coriacea sed tenuia breviter petiolata, petiolo 3–5 mm. longo late canaliculato; lamina rotundato-obovata vel late elliptico-obovata 2.5–3.5 cm. longa 1.5–2.8 cm. lata, apice subtruncata vel late rotundata, interdum apiculata vel emarginata, basi cuneata, vulgo subito contracta atque breviter acute decurrens, supra in sicco olivacea lucida, nervis venulisque prominulis, subtus concolor lucidaque, costa gracillima elevata, nervis lateralibus utroque latere 5–6 obliquis angulo semirecto vel angustiore adscendentibus prominulis inaequalibus, venulis inconspicuis vel obsoletis, margine pallido tenui; inflorescentiae spicatae simplices in axillis singulae vix ultra 5 mm. longae brevissime pedunculatae, floribus in spiculas trifloras parvas sessiles dispositis, bracteis obovatis vel spathulatis, apice obtusis vel rotundatis et apiculatis floribus brevioribus.—Honduras: Parasitic on a tree in semi-arid woodland near Coyoles, Dept. Yoro, July 26, 1938, *T. G. Yuncker, J. M. Koepfer & K. A. Wagner* 8662 (type in Herb. Field Mus.).

ARISTOLOCHACEAE**ARISTOLOCHIA L.**

Aristolochia grandiflora Swartz. Vine. Flowers very large and handsome, yellowish brown with purple mottling within, with vile, carrion-like odor. Climbing in thicket, foothills back of La Ceiba.

Aristolochia maxima L. Vine. Stems woody and with wide, corky wings; leaves oblong-obovate; flowers very dark red; fruit large, opening to form a basket-like structure. Climbing over shrubs in a thicket on the lower slopes of Mt. Cangrejal.

Aristolochia odoratissima L. Woody vine. Leaves ovate-cordate, acute; flowers large, cream with maroon mottling. Climbing in thicket, foothills back of La Ceiba.

Aristolochia pilosa HBK. Herbaceous vine. Stems, petioles, and pedicels covered with erect, brown hairs; leaves ovate-cordate, obtuse; outside of calyx limb dark red lined with green, inside deep violet spotted with yellow. Climbing in thicket, foothills back of La Ceiba.

POLYGONACEAE

COCCOLOBA L.

Coccoloba acuminata HBK. Shrub or small tree up to 2.5 meters tall and 3 to 5 cm. in diameter; spikes and fruit red. In ravines, semi-arid woodland region near Coyoles.

Coccoloba barbadensis Jacq. Small tree about 4.5 to 6 meters tall; leaves up to 25 cm. long; flowers green. On banks of ravine in semi-arid woodland region near Coyoles; also in open forest, foothills back of La Ceiba.

Coccoloba Browniana Standl. Tree about 7 meters tall; leaves rounded-ovate-cordate; fruit green, wrinkled. In semi-arid woodland region near Coyoles.

Coccoloba Tuerckheimii D. Sm. Tree about 7 meters tall; bark flaking; leaves obovate, very large; inflorescence with numerous long, bright red branches; flowers greenish white. In forest, foothills back of La Ceiba.

Coccoloba Uvifera (L.) Jacq. Tree about 7 meters tall and 20 cm. in diameter; leaves sessile, nearly round. In sandy soil near the beach, vicinity of La Ceiba.

POLYGONUM L.

Polygonum lapathifolium L. Herb, about 1 meter tall; flowers pale pink. On sandbar in the Cangrejal River, foothills back of La Ceiba.

Polygonum persicarioides HBK. Herb, about 60 cm. tall; flowers pale pink. On sandbars in the Aguán River, near Coyoles.

AMARANTHACEAE

AMARANTHUS L.

Amaranthus spinosus L. Weedy herb, mostly less than 1 meter tall, with numerous sharp, rigid spines. Common in waste places about La Ceiba.

GOMPHRENA L.

Gomphrena dispersa Standl. Plants low and sprawling; flower heads white to pink. A weedy, herbaceous plant, very common in waste places about La Ceiba; also at Coyoles.

IRESINE P. Br.

Iresine Celosia L. Herb. Scrambling over low shrubs in thicket on the bank of the Danto River, foothills back of La Ceiba.

Iresine nigra Uline & Bray. Small tree about 3.5 meters tall; spikelets short, white. In semi-arid woodland region near Coyoles.

NYCTAGINACEAE

BOERHAAVIA L.

Boerhaavia erecta L. Herb; flowers small, white. Weed, common in waste places in the semi-arid region about Coyoles; also in the vicinity of La Ceiba.

MIRABILIS L.

Mirabilis Jalapa L. Flowers purple-red. A single large colony found in the foothills back of La Ceiba.

NEEA Ruiz & Pavón

Neea psychotrioides D. Sm. Shrub or small tree about 4.5 meters tall; flowers greenish yellow. Frequent in forest on the foothills and lower slopes of Mt. Cangrejal.

PHYTOLACCACEAE

MICROTEA Swartz

Microtea debilis Swartz. A low, spreading, weedy herb; flowers very small, greenish white. In sandy soil near the Cangrejal River, foothills back of La Ceiba.

PETIVERIA L.

Petiveria alliacea L. Plant about 1 meter tall or less; stems woody at the base; spikes slender, up to 25 cm. long; flowers white.

In sandy soil on the bank of the Cangrejal River, foothills back of La Ceiba.

PHYTOLACCA L.

Phytolacca rivinoides Kunth & Bouché. Herb, about 2 meters tall; peduncles and pedicels red; flowers white; fruit dark purple. In an open, burned-over area near the Danto River on the slopes of Mt. Cangrejal, at 240 meters altitude.

RIVINA L.

Rivina humilis L. Low, weedy shrub; flowers white; fruit red. Frequent about La Ceiba.

AIZOACEAE

MOLLUGO L.

Mollugo verticillata L. A low, spreading, weedy herb; sepals white. In waste places about La Ceiba.

PORTULACACEAE

PORTULACA L.

Portulaca oleracea L. Low, succulent herb; corolla yellow. On sandbars in the Aguán River, near Coyoles.

Portulaca pilosa L. Low, succulent herb; corolla red. On gravel bars in the Aguán River, near Coyoles.

TALINUM Adans.

Talinum triangulare (Jacq.) Willd. Herb. Leaves succulent; flowers pale pink. In sandy soil, thicket along the Aguán River, near Coyoles.

NYMPHAEACEAE

NYMPHAEA L.

Nymphaea ampla (Salisb.) DC. Flowers white. In ponds near La Ceiba.

MENISPERMACEAE

CISSAMPELOS L.

Cissampelos tropaeolifolia DC. Vine. Leaves broadly ovate, peltate; flowers greenish; fruit red. Frequent in thickets, foothills back of La Ceiba.

DISCIPHANIA Eichl.

Disciphania calocarpa Standl. Woody vine; leaves ovate, acute, peltate; fruit very fleshy, orange-red. Climbing in thicket, foothills back of La Ceiba.

HYPERBAENA Miers

Hyperbaena hondurensis Standl. Woody vine; flowers yellowish orange, with carrion-like odor. Climbing in trees, thickets on banks of the Danto River, slopes of Mt. Cangrejal, at 150 meters altitude.

MAGNOLIACEAE

TALAUMA Juss.

Talauma mexicana (DC.) Don. A tree about 15 meters high, in forest on slopes of Mt. Cangrejal, at 180 meters, No. 8845. The material available for study consists of a young branch with two large leaves and a detached young fruit. At first I was inclined to believe, partly because of its geographic origin, that a new species was represented, and such, in fact, may well be the case. However, the material of the genus available for comparison is so scant and incomplete that it does not seem desirable at present to describe the Honduran tree as new. It is noteworthy for the unusually large leaves, as much as 42 cm. long and 16 cm. wide, and for the very large young fruit, with exceedingly numerous carpels. Further material from Honduras and Mexico is needed before it can be decided definitely whether the Honduran form is actually *T. mexicana* or an undescribed species.—PAUL C. STANDLEY.

ANNONACEAE

ANNONA L.

Annona reticulata L. Tree up to 15 meters tall and 50 cm. in diameter; flower parts fleshy. In open forest near the village of Las Flores, at 300 meters altitude; also in forest on foothills back of La Ceiba.

MYRISTICACEAE

COMPSONEURA Warb.

Compsonеura Sprucei (A. DC.) Warb. Tree about 6 meters tall; flowers small, numerous, cream-colored; fruit with a thin, fleshy coat and a single seed about 2 cm. long, covered with an aril.

On the bank of the Salado River, about 20 kilometers west of La Ceiba.

MONIMIACEAE

SIPARUNA Aubl.

Siparuna nicaraguensis Hemsl. Tree about 6 meters tall; fruit fleshy, pink, aromatic. Margin of the Danto River, slopes of Mt. Cangrejal, at 300 meters altitude.

LAURACEAE

MISANTECA C. & S.

Misanteca capitata C. & S. Tree about 7 meters tall; fruit green, partially enclosed in a red cup. In deep forest on the slopes of Mt. Cangrejal, at 330 meters altitude.

NECTANDRA Roland

Nectandra sanguinea Rottb. Tree about 10 meters tall and 35 cm. in diameter; flowers white. In open forest, semi-arid upland region near the village of Las Flores, at 300 meters altitude; also in forest, foothills near the Cangrejal River back of La Ceiba.

OCOTEA Aubl.

Ocotea cernua (Nees) Mez. Tree about 7 meters tall. In open forest on the foothills near the Cangrejal River, back of La Ceiba.

PHOEBE Nees

Phoebe helicterifolia Mez. Tree about 9 meters tall; flowers creamy white. On the banks of the Danto River, lower slopes of Mt. Cangrejal, back of La Ceiba.

Phoebe mexicana Meissn. Tree about 7 meters tall; leaves shiny above; pedicels red. In a ravine near the village of Medina, at 180 meters altitude.

CRUCIFERAE

CAKILE Mill.

Cakile lanceolata (Willd.) O. E. Schulz. Low herb; flowers white; fruit 1-seeded. In sand near the seashore, vicinity of La Ceiba.

CAPPARIDACEAE

CAPPARIS L.

Capparis admirabilis Standl., sp. nov.—Arbuscula 3.5 m. alta, trunco 7 cm. diam., ramis rectis rigidis teretibus vel subcompressis dense adpresso-lepidotis, internodiis brevibus; folia brevissime petiolata coriacea adscendentia vel suberecta, petiolo crasso vix ultra 3 mm. longo; lamina linearis 13–23 cm. longa prope basin 10–12 mm. lata e basi rotundata usque apicem angustum sensim attenuata, supra primo dense adpresso-stellato-pilosula, cito glabrata, nervis venisque prominulis, subtus ubique dense adpresse albido-lepidota, costa crassa elevata, nervis numerosis valde obliquis angulo acuto adscendentibus, venulis prominentibus arctissime reticulatis; inflorescentiae axillares cymoso-corymbosae longipedunculatae folia aequantes, pedunculis ramisque compressis dense lepidotis, pedicellis 5–7 mm. longis; sepala in alabastro aperta deltoideo-ovata acutiuscula ca. 1 mm. longa vel paullo ultra; petala inaequalia ochroleuca spathulato-obovata usque 1 cm. longa apice rotundata intus glabra extus dense stellato-tomentosa; stamina 8 petalis duplo longiora, filamentis basi stellato-pilosis; gynophorum ca. 1 cm. longum glabrum, ovario oblongo dense lepidoto.—Honduras: In woodland in semi-arid region near Coyoles, Dept. Yoro, June 29, 1938, *T. G. Yuncker, J. M. Koepfer & K. A. Wagner* 8130 (type in Herb. Field Mus.).

A well marked species, altogether unlike any other known from Central America. Most remarkable are the long and narrow, rigid leaves, which recall those of certain species of northern South America. Noteworthy, also, is the small number of stamens, but the plant seems better referable to *Capparis* than to other genera of the family, to which the stamen number might seem to necessitate its reference.

Capparis indica (L.) Fawc. & Rendle. Tree about 4.5 meters tall. In semi-arid woodland region near the village of Las Flores.

Capparis Yunckeri Standl., sp. nov.—Frutex scandens, ramis viridibus vel viridescentibus subteretibus, novellis densissime pilis stellatis sessilibus atque stipitatis intermixtis tomentosis, internodiis brevibus; folia parva breviter petiolata in sicco coriacea, petiolo crasso 5–7 mm. longo stellato-tomentoso; lamina elliptico-ovalis vel subrotundata 2.5–4.5 cm. longa 2–3.5 cm. lata apice rotundata, basi late rotundata vel truncata, supra in statu juvenili dense stellato-tomentosa, cito glabrata, nervis profunde impressis, subtus pallida

ubique dense stellato-tomentosa, nervis costaque prominentibus sed tomento occultis, nervis lateralibus utroque latere 4-5; flores non visi; fructus (imperfectus solum visus) 2.5 cm. longe pedunculatus, gynophoro 5 mm. longo; bacca ut videtur ellipsoidea ca. 5 cm. longa glabrata sed pilis minutis stellatis hinc inde conspersa.—Honduras: Climbing in a thicket in woodland, semi-arid region near Coyoles, Dept. Yoro, July 25, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8615 (type in Herb. Field Mus.).

This also is an outstanding plant in the genus *Capparis*, and I have found no species to which it is at all similar. It is noteworthy for its scandent habit and for the small, broad, copiously stellate-tomentose leaves.

CLEOME L.

Cleome aculeata L. Herb about 60 cm. tall, with a pair of short, slightly recurved prickles at the lower nodes; seeds reddish. In waste area near La Ceiba.

Cleome serrata Jacq. Weedy herb with stem somewhat woody at the base; flowers creamy white. In waste places on the plains and in the foothills about La Ceiba.

PODOSTEMONACEAE

TRISTICHA Thou.

Tristicha hypnoides Spreng. Aquatic herb, superficially resembling certain aquatic bryophytes. Stems slender, branching; leaves minute, in three rows. Covering submerged rocks in current of swift mountain stream on the slopes of Mt. Cangrejal, at 270 meters altitude.

HAMAMELIDACEAE

LIQUIDAMBAR L.

Liquidambar styraciflua L. Tree about 7 meters tall and 20 cm. in diameter. This species, common in the southeastern United States, has been previously reported from the highlands about Siguatepeque. Occasional in deep forest on the slopes of Mt. Cangrejal, at 300 meters altitude.

ROSACEAE

HIRTELLA L.

Hirtella triandra Swartz. Small tree about 4.5 meters tall. On the rocky bank of the Danto River, lower slopes of Mt. Cangrejal.

LEGUMINOSAE

ABRUS L.

Abrus precatorius L. Woody vine. Seeds bright red with a black spot, handsome and often used as ornaments. Occasional in thickets on the lower slopes of Mt. Cangrejal.

ACACIA Willd.

Acacia riparia HBK. Low, spreading tree about 7 meters tall and 30 cm. in diameter, armed with a pair of short, recurved prickles at the nodes; leaves bipinnate, with numerous very small leaflets; flowers white. Common in woodland and open pastures in semi-arid region in the Aguán River Valley above Olanchito and about Coyoles.

Acacia spadicigera Schl. & Cham. Small tree or shrub about 2 meters tall, armed with pairs of large, nodal, bullhorn-like spines inhabited by colonies of a small but exceedingly vicious species of ant. Occasional in semi-arid woodland near Coyoles.

Acacia telensis Standl. Woody vine, the older branches 4-angled, armed with numerous small, more or less recurved prickles; pods large, thin. In thickets near the Danto River, slopes of Mt. Cangrejal, at 180 meters altitude; also in thickets on the plain back of Roma, about 25 kilometers east of La Ceiba.

BAUHINIA L.

Bauhinia divaricata L. Shrub or small tree about 4.5 meters tall; flowers white to pale pink. In forest on the slopes of Mt. Cangrejal, at 150 meters altitude.

Bauhinia hondurensis Standl. A coarse, woody vine; corolla white. Climbing in thickets on the foothills back of La Ceiba; also in a ravine near the village of Medina, at 200 meters altitude.

Bauhinia sp. A large, woody species with strongly flattened stems which curve in a regular zigzag manner was frequently observed climbing in trees in forests on the lower slopes back of La Ceiba. No plants, however, were found in flower or fruit.

BENTHAMANTHA Alef.

Benthamantha mollis (HBK.) Alef. A low shrub less than 1 meter tall; flowers yellowish. In semi-arid woodland region near Coyoles.

CALLIANDRA Benth.

Calliandra arborea Standl. Shrub or small tree up to 6 meters tall. Stamens long and bright red, making a showy flower cluster. Originally described from specimens collected near Siguatepeque. In thickets, foothills back of La Ceiba; also in open forest on rocky mountain slope above Roma, about 25 kilometers east of La Ceiba, at 360 meters altitude.

Calliandra confusa Sprague & Riley. Shrub about 2.5 meters tall; leaflets very small and numerous; stamens long, bright red. Forming thickets in the rocky bed of the Danto River, slopes of Mt. Cangrejal, at 240 meters altitude.

CALOPOGONIUM Desv.

Calopogonium coeruleum Benth. A large vine, woody below; flowers large, purple or lavender, produced in abundance in long, handsome racemes. Common in thickets on the lower slopes of Mt. Cangrejal back of La Ceiba.

CASSIA L.

Cassia bacillaris L. Shrub or small tree up to 7 meters tall; flowers large, creamy yellow, showy. In thickets, foothills back of La Ceiba.

Cassia occidentalis L. Herb up to 1 meter tall; flowers yellow. Abundant in sandy soil, thickets along the Aguán River near Coyoles.

Cassia riparia HBK. Herb up to 1 meter tall; flowers yellow. Common along trails in the foothills back of La Ceiba.

CROTALARIA L.

Crotalaria retusa L. Herb about 75 cm. tall. Flowers rather pretty, the petals yellow within, reddish brown outside. Abundant on gravelly bars in the Aguán River near Coyoles.

Crotalaria striata Schrank. Herb about 90 cm. tall; corolla yellow, streaked with red. In sand near the seashore, vicinity of La Ceiba.

Crotalaria vitellina Ker. Herb about 60 cm. tall; flowers yellow. On gravelly bar in the Aguán River, near Coyoles.

CYNOMETRA L.

Cynometra retusa Britt. & Rose. A handsome tree about 30 meters tall and 1 meter in diameter, the base strongly buttressed.

Leaflets 2; pods subglobose, brown-scurfy. On river bank, foothills back of La Ceiba.

DESMODIUM Desv.

Desmodium axillare (Swartz) DC. Herb. Stems creeping; flowers on erect branches, dark red. Common along trails in the foothills back of La Ceiba.

DIALIUM L.

Dialium guianense (Aubl.) Steud. Tree about 15 meters tall; pods globose-ovoid, smooth, 2 cm. long. Wood said to be very hard and useful for construction purposes requiring resistant timber. In forests on the lower slopes of Mt. Cangrejal.

ENTADA Adans.

Entada polystachia (L.) DC. Woody vine with thick, trunk-like stem; flowers with strong carrion-like odor; stamens white; corolla reddish. In open forest on the foothills back of La Ceiba.

ENTEROLOBIUM Mart.

Enterolobium cyclocarpum (Jacq.) Griseb. A very large tree. This and the ceiba are the two largest trees of the region. Occasional in forest and pastures of the Aguán River Valley. Originally abundant.

ERYTHRINA L.

Erythrina hondurensis Standl. A small tree about 7.5 meters tall, armed with short, stout prickles. Leaflets 3, large; pods abundant, long; seeds scarlet. Banks of the Danto River, slopes of Mt. Cangrejal, 180 meters altitude; also in the semi-arid woodland region near Coyoles.

GLIRICIDIA HBK.

Gliricidia sepium (Jacq.) Steud. Tree about 6 meters tall and 15 cm. in diameter; flowers pink. Abundant on the plains about La Ceiba, where it is extensively used for living fence posts.

INGA Scop.

Inga edulis Mart. Broad-topped tree about 7 meters tall and 20 cm. in diameter. Pods brown-pubescent, twisted. On banks of the Salado River, about 20 kilometers west of La Ceiba; also in an upland ravine near the village of Medina, at 150 meters altitude.

Inga Pittieri Micheli. Tree about 7 meters tall. Pods large, green, smooth, strongly 4-angled. On the plain back of Roma, about 25 kilometers east of La Ceiba.

Inga Roussoviana Pittier. Tree about 7 meters tall; corolla greenish white; stamens white. On the low banks of the Salado River about 20 kilometers west of La Ceiba; also in open forest on the plains back of Roma, about 25 kilometers east of La Ceiba.

Inga Yunckeri Standl., sp. nov.—Arbor 9-metralis, ramulis glabratis fusco-ferrugineis lenticellis numerosis pallidis parvis conspersis; folia mediocria 2 cm. longe petiolata, rhachi ca. 2.5 cm. longa exalata fere omnino glabra; foliola bijuga oblongo-elliptica subaequalia 13–18.5 cm. longa 7–8.5 cm. lata acuta vel breviter acuminata, basi acuta, crasse membranacea, supra in sicco viridia lucida glabra, costa nervisque prominentibus, subtus concoloria sublucida saltem in statu adulto omnino glabra, costa gracili elevata, nervis lateralibus utroque latere ca. 10; flores spicati, spicis brevibus dense multifloris pedunculatis, pedunculis lutescenti-hispidulis usque 18 mm. longis, rhachi ca. 1 cm. longa, bracteis minutis inconspicuis, spicis in paniculas parvas densas ca. 7 cm. longas atque aequilatas aggregatis; calyx tubulosus 6 mm. longus glaber striatus, sursum paullo dilatatus, dentibus brevibus apice rotundatis; corolla viridis 10–12 mm. longa dense fulvido-sericea, lobis lanceolato-oblongis attenuato-acuminatis 2 mm. longis; stamina alba usque 2.5 cm. longa. —Honduras: In foothills back of La Ceiba, near Cangrejil River, August 4, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8805 (type in Herb. Field Mus.).

INDIGOFERA L.

Indigofera lespedezioides HBK. Plants up to 1 meter tall, slender, suffruticose. Flowers salmon-colored. In rocky soil on the mountain slope above the village of Las Flores, at 300 meters altitude.

LONCHOCARPUS HBK.

Lonchocarpus Michelianus Pittier. Handsome tree about 18 meters tall. Flowers about 1.5 cm. long, pinkish to lavender, abundant, showy. Solitary in open grassland near the Cangrejil River, foothills back of La Ceiba.

Lonchocarpus yoroensis Standl., sp. nov.—Arbor 6-metralis, ramulis fusco-brunnescentibus crassis teretibus lenticellis parvis pallidis conspersis, novellis sat dense minuteque adpresso-pilosulis,

internodiis abbreviatis; stipulae inconspicuae late ovato-deltaideae obtusae ca. 1.5 mm. longae; folia inter minora petiolata, rhachi petiolo adjecto 3–4 cm. longa gracili dense puberula; foliola 5 ca. 2 mm. longe petiolulata elliptica vel obovata paullo inaequalia 2.5–6 cm. longa 2–3 cm. lata apice obtusa vel anguste rotundata, basi obtusa vel subacuta, supra dense breviter pilosula, subtus dense pilis pallidis subpatentibus molliter pilosa, nervis lateralibus utroque latere ca. 5; inflorescentia (cum alabastris tantum visa) spiciformis folia aequans, longipedunculata laxe pauciflora, rhachi dense adpresso-pilosula, floribus sessilibus vel breviter pedicellatis, bracteis bracteolisque late ovatis obtusis adpresso-pilosulis; legumen (perfectum non visum) compressum 1.5 cm. latum, suturis tenuibus, seminibus ut videtur 1 vel pluribus.—Honduras: In semi-arid upland near Medina, Dept. Yoro, alt. 180 meters, July 26, 1938, *T. G. Yuncker, J. M. Koepfer & K. A. Wagner* 8658 (type in Herb. Field Mus.).

MACHAERIUM Pers.

Machaerium Pittieri Macbr. Small tree about 5 meters tall. Flowers small, purplish. In forest on the lower slopes of Mt. Cangrejal.

MIMOSA L.

Mimosa pigra L. Shrub or small tree 2.5 to 3.5 meters tall, armed with short, stout prickles. Leaflets numerous, small; flowers pink; pods brown-hairy. On gravelly bar in the Aguán River, near Coyoles; also in sandy soil near the seashore, vicinity of La Ceiba. Common.

Mimosa pudica L. Low, prostrate, suffrutescent. Flowers pink. A common, weedy plant about La Ceiba; also frequent in waste places in the Aguán River Valley.

PHASEOLUS L.

Phaseolus adenanthus Mey. Herbaceous vine. Flowers purplish yellow. Climbing in thickets on the banks of the Danto River, slopes of Mt. Cangrejal, at 150 meters altitude.

PITHECOLOBIUM Mart.

Pithecolobium dulce (Roxb.) Benth. Small tree with gray bark, about 6 meters tall, armed with sharp, stout spines; leaflets 2, oblique, about 2 cm. long. A common and characteristic tree in the semi-arid woodland region near Coyoles.

Pithecolobium guatemalense (Britt. & Rose) Standl. Tree about 6 meters tall and 15 to 20 cm. in diameter. Leaflets numerous, oblique, about 1.5 cm. long, softly pubescent. Only sterile material was obtainable and the identification is uncertain. A characteristic tree in open forests in the semi-arid region near the village of Las Flores.

Pithecolobium longifolium (H. & B.) Standl. Small tree about 6 meters tall. Flowers greenish white, in globose, head-like clusters; pods scarlet; seeds black. Frequent in forests on the foothills back of La Ceiba.

Pithecolobium tenellum (Britt. & Rose) Standl. Small tree about 6 meters tall. Flowers greenish white, in globose, head-like clusters; pods scarlet; seeds black. Frequent in forests on the foothills back of La Ceiba.

POEPPIGIA Presl

Poeppigia procera Presl. A handsome tree about 12 meters tall and 35 cm. in diameter. Leaves light green, pinnate; leaflets numerous, about 1 cm. long; flowers yellow, 1 cm. long, numerous, in paniculately racemose clusters. In open woodland near the village of Medina, at about 180 meters altitude.

SWARTZIA Schreb.

Swartzia simplex (Swartz) Spreng. Small tree about 7 meters tall. Leaves with a solitary, large leaflet; flower buds globose; corolla yellow. Frequent along the Danto River, slopes of Mt. Cangrejal.

VIGNA Savi

Vigna repens (L.) Kuntze. Trailing, herbaceous vine with yellow flowers. On sandy ocean beach near the village of Salado.

Vigna vexillata (L.) A. Rich. Herbaceous vine with hairy stem. Flowers white to light lavender. Climbing in thickets, foothills back of La Ceiba.

OXALIDACEAE

BIOPHYTUM DC.

Biophytum dendroides (HBK.) DC. Herb about 15 cm. tall; leaves clustered at the top of the stem; flowers pink. Along the margin of the Danto River, slopes of Mt. Cangrejal, at 150 meters altitude.

OXALIS L.

Oxalis Neaei DC. Herb 30 cm. high or more; flowers yellow. Common in open areas throughout the region.

RUTACEAE**AMYRIS L.**

Amyris sylvatica Jacq. Small tree about 3.5 meters tall. Leaves 3-foliolate. In semi-arid woodland region near Coyoles.

CITRUS L.

Citrus sinensis Osbeck. Seedling trees encountered frequently along the trails and in open forest areas throughout the region.

ZANTHOXYLUM L.

Zanthoxylum Fagara (Jacq.) Sarg. Tree about 4.5 meters tall. Fruit small, green. Frequent in open forest in the semi-arid region near the village of Medina.

BURSERACEAE**BURSERA Jacq.**

Bursera Simaruba (L.) Sarg. Tree up to 15 meters tall or more; bark smooth, copper-brown, peeling in thin sheets. Frequent in semi-arid forest area near Coyoles; also in forests on the foothills back of La Ceiba.

MELIACEAE**GUAREA Allem.**

Guarea excelsa HBK. Tree about 6 meters tall or more. Flowers small, white, in many-flowered, slender panicles up to 25 cm. long. In deep forest along the Danto River, slopes of Mt. Cangrejal, at 150 to 300 meters altitude.

MELIA L.

Melia Azedarach L. Small tree about 6 meters tall and 15 cm. in diameter; flowers lavender; fruit yellow. Naturalized in the foothills back of La Ceiba.

SWIETENIA Jacq.

Swietenia macrophylla King. Large forest tree with trunk 90 cm. or more in diameter. Abundant in certain parts of the Aguán River Valley, where mahogany is being cut commercially.

TRICHILIA L.

Trichilia acutanthera C. DC.(?) Tree about 6 meters tall. Capsule less than 1 cm. long, yellow. On the banks of the Salado River about 20 kilometers west of La Ceiba; also in forests on the lower slopes of Mt. Cangrejal.

Trichilia havanensis Jacq. Small tree about 4.5 meters tall and 15 cm. in diameter. Leaves pinnate, the leaflets mostly 5-7; capsule small. In forest on the foothills back of La Ceiba.

MALPIGHIACEAE

BYRSONIMA Rich.

Byrsonima crassifolia (L.) DC. Small tree or shrub about 4.5 meters tall. Flowers showy, at first yellow, later turning reddish orange, in terminal racemes; fruit fleshy, yellow, edible. Abundant throughout the plains and foothills.

HETEROPTERIS HBK.

Heteropteris laurifolia (L.) Juss. Woody vine. Flowers yellow; fruit a samara. In thickets near the village of Las Flores, at 180 meters altitude.

HIRAEA Jacq.

Hiraea obovata (HBK.) Ndzu. Shrub or small tree about 3 meters tall. Flowers yellow; fruit a samara. In forests along the Danto River, slopes of Mt. Cangrejal, at 180 meters altitude.

STIGMAPHYLLON Juss.

Stigmaphyllon puberum (Rich.) Juss. A large, woody vine. Flowers large and showy, the petals orange and red; fruit a samara. Climbing in thickets along the Danto River, slopes of Mt. Cangrejal, at 210 meters altitude.

TETRAPTERIS Cav.

Tetrapteris Schiedeana Schl. & Cham. Woody vine. Flowers yellow; fruit a samara. Climbing in thickets along the Danto River on the slopes of Mt. Cangrejal, at 180 meters altitude.

VOCHYSIACEAE

VOCHYSIA Juss.

Vochysia hondurensis Sprague. Tree about 12 meters tall and 35 cm. in diameter. Fruit 3-angled, 3 cm. long or more. In forests on the lower slopes of Mt. Cangrejal.

DICHAPETALACEAE

DICHAPETALUM Thou.

Dichapetalum Donnell-Smithii Engler. Somewhat scandent shrub about 7 meters tall. Leaves oblong-obovate, 10 to 15 cm. long, abruptly acute. In deep forests along the Danto River on the slopes of Mt. Cangrejal, at 300 meters altitude.

EUPHORBIACEAE

ACALYPHA L.

Acalypha costaricensis (Kuntze) Knobl. Plants herbaceous or slightly woody at the base, about 1 meter tall. Staminate spikes slender; pistillate flowers in open panicles; fruit red. In open areas in the forest, slopes of Mt. Cangrejal back of La Ceiba. Common.

Acalypha diversifolia Jacq. Shrub or small tree about 4.5 meters tall. Flowers in slender spikes, small, greenish. Common on the slopes back of La Ceiba, up to 300 meters altitude, also frequent in the semi-arid woodland about Coyoles, and on the slopes above Las Flores, at 270 meters altitude.

Acalypha villosa Jacq. Shrub or small tree up to 7 meters tall. Staminate spikes long and slender; pistillate flowers in panicles. In thickets along the Danto River, slopes of Mt. Cangrejal, at 150 meters altitude; also in the semi-arid woodland region near Coyoles.

CROTON L.

Croton ciliato-glandulosus Ortega. Shrub, mostly 1 meter tall or less. Flowers greenish white. In sandy soil, semi-arid region near Coyoles.

Croton flavens L. Shrub, 1 meter tall or less, densely covered with stellate hairs. Flowers yellowish. In semi-arid woodland region near Coyoles.

Croton glabellus L. Small tree about 7 meters tall and 30 cm. in diameter, covered with small, brownish scales. Flowers white; fruit green, rough, about 1 cm. in diameter. In forest, foothills back of La Ceiba.

Croton lobatus L. Herb about 1 meter tall. Leaves 3-lobed. On sandy bar in the Aguán River, near Coyoles.

Croton punctatus Jacq. A low, more or less decumbent shrub 45 to 60 cm. tall, densely covered with brown, stellate scales. Flowers yellowish. In sandy soil near the seashore, vicinity of La Ceiba.

Croton repens Schlecht. Shrub about 1 meter tall, moderately covered with stellate hairs. Leaves shallowly dentate, rounded-ovate; flowers white. In rocky soil, mountain slope above the village of Las Flores, at 330 meters altitude.

DALECHAMPIA L.

Dalechampia spathulata (Scheidw.) Baill. Small shrub 30 to 60 cm. tall. Bracts dark red. In rich soil in deep forest near the Danto River, slopes of Mt. Cangrejal back of La Ceiba.

EUPHORBIA L.

Euphorbia heterophylla L. Herb up to 1.5 meters tall. Leaves variable in shape and size, the uppermost, which subtend the flowers, frequently pink at the base. Common along streams in the foothills back of La Ceiba.

Euphorbia nereifolia L. Tree-like, about 3.5 meters tall, with many ascending, longitudinally ridged branches, armed with short spines on the ridges. Leaves obovate, more or less terminally clustered. In thicket in semi-arid upland near Las Flores.

JATROPHA L.

Jatropha Curcas L. Tree about 4.5 meters tall and 20 cm. in diameter. Leaves large, lobed and more or less resembling those of a maple; fruit about 2.5 cm. long, fleshy. In forest, foothills back of La Ceiba.

Jatropha gossypifolia L. Shrub about 1 meter tall. Leaves 3- or 5-lobed, marginally glandular-ciliate; flowers red. In sandy soil, thicket near the Aguán River below Coyoles.

Jatropha urens L. Shrub about 2 meters tall or less. Leaves lobed; flowers white, conspicuous. Branches and leaves covered with stiff, stinging hairs which produce an exceedingly painful sensation. Frequent throughout the semi-arid region about Coyoles.

MABEA Aubl.

Mabea occidentalis Benth. Shrub or small tree about 3 meters tall. Leaves 12 to 18 cm. long, oblong, abruptly acuminate; flowers in terminal, long-stalked, paniculate racemes. In forest on the slopes of Mt. Cangrejal, at 240 meters altitude.

PEDILANTHUS Poit.

Pedilanthus tithymaloides Poit. Slender, nearly leafless shrub about 1 meter tall. Stems smooth, green; flowers small,

subtended by a conspicuous, slipper-like involucre bract. Frequent throughout the semi-arid woodland region about Coyoles.

PHYLLANTHUS L.

Phyllanthus Bartlettii Standl. Low shrub, 30 to 45 cm. tall. Branches very slender; leaves thin, lanceolate, acute; flowers small, greenish white. In thickets on the lower slopes of Mt. Cangrejal, back of La Ceiba. Known previously only from Guatemala.

Phyllanthus nobilis (L. f.) M. Arg. var. **hypomalacus** Standl. Tree about 7 meters tall and 20 cm. in diameter. In open forest area near the village of Las Flores.

RICINUS L.

Ricinus communis L. Herb about 3 meters tall, the stems somewhat woody below. Forming dense thickets in open, sandy areas near the Aguán River below Coyoles.

SAPIUM Jacq.

Sapium jamaicense Swartz. Tree about 10 meters tall; wood very brittle; sap milky, abundant; flowering spikes long and slender. At edge of forest on the lower slopes of Mt. Cangrejal.

ANACARDIACEAE

ANACARDIUM L.

Anacardium occidentale L. Tree about 6 meters tall and 15 cm. in diameter. Fruit edible. On the bank of the Salado River, about 20 kilometers west of La Ceiba.

MANGIFERA L.

Mangifera indica L. Several large trees were observed as escapes on the plains and lower slopes about La Ceiba.

SPONDIAS L.

Spondias Mombin L. Fine, smooth-barked tree about 18 meters tall and 90 cm. in diameter. Flowers small, greenish, in large, terminal, panicle clusters. Fruit edible. Frequent on the plains and lower foothills about La Ceiba.

Spondias purpurea L. Small tree about 4.5 meters tall. Fruit red, edible. In open forest near the village of Las Flores.

SAPINDACEAE

CUPANIA L.

Cupania glabra Swartz. Small tree about 6 meters tall. Flowers yellowish white, small, in large, paniculate clusters; fruit a brown, scurfy, 3-seeded capsule. In forest, foothills near the Cangrejal River back of La Ceiba; also in open forests in semi-arid upland near the village of Las Flores, at 200 meters altitude.

PAULLINIA L.

Paullinia pinnata L. Coarse, woody vine. Leaves pinnate, the rachis winged. Inflorescence paniculately racemose, slender, with one or more tendrils; flowers white; fruit red. Climbing in thickets in the foothills back of La Ceiba; also in semi-arid woodland region near Coyoles.

VITACEAE

CISSUS L.

Cissus rhombifolia Vahl. Woody vine. Stem 4-angled, winged; leaves 3-foliolate; pedicels, peduncles, and flower buds bright red. Climbing in thickets on the foothills of Mt. Cangrejal.

Cissus salutaris HBK. Woody vine. Leaves 3-foliolate; parts of flower clusters red. Climbing in thickets on the rocky mountain slope in open pine forest above the village of Las Flores, at 330 meters altitude.

Cissus sicyoides L. Woody vine. Leaves simple, very hairy; flowers greenish; fruit fleshy, black. Climbing in thickets near La Ceiba; also in thickets along the Aguán River near Coyoles, and near the village of Medina in the semi-arid region.

VITIS L.

Vitis tiliifolia Humb. & Bonpl. Large, woody vine. Leaves broadly ovate, shallowly lobed, densely hairy; flowers small, green; fruit fleshy, small, black. Climbing in thickets, foothills back of La Ceiba.

TILIACEAE

BELOTIA A. Rich.

Belotia Campbellii Sprague. Tree about 4.5 meters tall. Leaves oblong, sharply acuminate, pubescent with simple or branching hairs; fruit about 1 cm. long, dry, 2-celled. In forests on the

rocky ridge back of Roma, about 25 kilometers east of La Ceiba, at 270 meters altitude.

LUEHEA Willd.

Luehea candida (DC.) Mart. Tree about 9 meters tall and 30 cm. in diameter. Leaves oval-obovate, densely pubescent with stellate hairs; flowers about 5 cm. wide, handsome; petals at first white, turning brown; fruit dry and woody, about 6 cm. long, splitting into 5 lobes. Frequent in the semi-arid upland region of the Aguán River Valley.

Luehea speciosa Willd. Tree about 6 meters tall. Leaves oval-obovate, sharply acuminate, pubescent with stellate hairs; flowers white; fruit dry and woody, about 3 cm. long. On the ridge back of Roma, about 25 kilometers east of La Ceiba, between 300 and 600 meters altitude.

MUNTINGIA L.

Muntingia Calabura L. Tree about 6 meters tall and 30 cm. in diameter. Leaves oblong-lanceolate, densely hairy with branched hairs; corolla white; fruit fleshy, red, edible. In sandy soil in Aguán River bottoms near Coyoles.

TRIUMFETTA L.

Triumfetta polyandra DC. Herbaceous, about 1 meter high; in open forest, rocky mountain slope, above Las Flores, 300 meters, No. 8167. Also Monte de la Flor, Tegucigalpa, at 960 meters, pine and oak region, December, 1937, *Christine & Wolfgang von Hagen* 1213; a shrub of 30–60 cm.; vernacular name “oreja de coyote.” I was at first inclined to believe that the Honduran collections represented a new species, and both were given a provisional name, but further study convinces me that the material is actually referable to *T. polyandra*, which is rather widely distributed in Mexico, and occurs also in Guatemala.—PAUL C. STANDLEY.

MALVACEAE

ANODA Cav.

Anoda cristata (L.) Schlecht. Herb about 45 cm. tall. Leaves lobed; flowers light blue. In waste areas about La Ceiba.

MALVAVISCUS Cav.

Malvaviscus palmanus D. Sm. Small tree or shrub about 3.5 meters tall. Leaves long-petioled, ovate; flowers bright red. In

moist, shady ravines on mountain slope near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

PAVONIA Cav.

Pavonia rosea Schlecht. Herb, somewhat woody at the base, about 1 meter tall; corolla rose. In sandy soil near the Salado River, about 20 kilometers west of La Ceiba.

SIDA L.

Sida cordifolia L. Herb, somewhat woody at the base, about 1 meter tall; flowers salmon-colored. In sandy soil, waste areas in semi-arid region about Coyoles.

Sida rhombifolia L. Herb about 1 meter tall, somewhat woody at the base; flowers buff. On mountain slope near Puente Alto, about 50 kilometers east of La Ceiba, at 250 meters altitude.

BOMBACACEAE

CEIBA Medic.

Ceiba pentandra (L.) Gaertn. A very large, smooth-barked tree, commonly with wide buttresses. Occasional on the plains and in forest on the foothills. Originally abundant in the Aguán River Valley, but large numbers of the trees have been cut.

HAMPEA Schlecht.

Hampea stipitata Wats. Tree about 6 meters tall. Leaves more or less stellate-pubescent; fruit a globose capsule. In rocky ravines on mountain slope near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

OCHROMA Swartz

Ochroma limonensis Rowlee. Tree about 9 meters tall. Occasional on the plains and lower foothills about La Ceiba.

QUARARIBEA Aubl.

Quararibea Yunckeri Standl., sp. nov.—Arbor 12-metralis, trunco 45 cm. diam., ramulis gracilibus subteretibus nigris vel fuscis rimosis minute adpresso-lepidotis; folia mediocria breviter petiolata coriaceo-membranacea, petiolo 5–8 mm. longo dense minute adpresso-lepidoto; lamina anguste oblonga 10–18 cm. longa 3–5.5 cm. lata subabrupte longiuscule acuminata, basi obtusa vel acutiuscula,

integra, supra flavido-viridis sublucida fere glabra sed ad nervos sparse minute lepidota, nervis manifestis sed vix elevatis, subtus concolor glabra vel ad nervos sparse lepidota, in axillis nervorum domatiata atque dense barbata, nervis lateralibus utroque latere ca. 5 subarcuatis prominentibus valde adscendentibus, venis prominulis laxissime reticulatis; flores axillares et e nodis defoliatis nascentes singuli breviter crasseque pedunculati, bracteolis parvis late ovatis acutis adpressis; alabastra obtusissima; calyx infundibuliformis fere 1 cm. longus fauce 5 mm. latus extus densissime adpressaeque stellato-lepidotus, superne breviter lobatus, lobis rotundatis intus sericeis; petala alba calyce multo longiora angusta stellato-pilosula; tubus staminalis ca. 7 mm. longe exsertus stellato-pilosulus. —Honduras: River bank, foothills back of La Ceiba, Dept. Atlántida, June 25, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8010 (type in Herb. Field Mus.).

The flowers are much smaller than those of most other Central American representatives of the genus.

STERCULIACEAE

GUAZUMA Adans.

Guazuma ulmifolia Lam. Tree about 6.5 meters tall. Leaves pubescent with stellate hairs; corolla yellow; fruit a subglobose, rough, woody capsule. Frequent in the semi-arid upland region about Las Flores, up to 360 meters in altitude.

HELICTERES L.

Helicteres guazumaefolia HBK. Shrub or small tree about 3 meters tall. Leaves oval-obovate, serrate, with stellate pubescence; flowers tubular; corolla red; stamen tube much exserted; fruit woody and spirally twisted like the threads of a screw. In semi-arid upland region near the village of Medina, at 180 meters altitude.

STERCULIA L.

Sterculia apetala (Jacq.) Karst. Tree about 12 meters tall. Leaves palmately 3- or 5-lobed, densely pubescent beneath with stellate hairs. In forests on the lower slopes of Mt. Cangrejal.

DILLENIACEAE

CURATELLA L.

Curatella americana L. Small tree about 4.5 meters tall. Leaves rough and pubescent with scattered, stellate hairs; fruit

bright red within. On rocky mountain slopes in open pine forest above the village of Las Flores, at 330 meters altitude.

DAVILLA Vand.

Davilla Kunthii St. Hil. Tree-like, about 6 meters tall and 20 cm. in diameter. Leaves thick, pinnately nerved, very rough, with short, stiff, bristle-like hairs; flowers in a large, terminal, densely hairy panicle; fruit orange-colored. In forests on the foothills back of La Ceiba.

ACTINIDIACEAE

SAURAUIA Willd.

Saurauia Englesingii Standl. Tree about 10 meters tall. Leaves large, obovate, rough-bristly; flowers showy, in terminal, densely hairy panicles; corolla white; stamens yellow. In deep forest near the falls of the Danto River, slopes of Mt. Cangrejal, at 360 meters altitude.

Saurauia pauciserrata Hemsl. Tree about 7 meters tall. Leaves light green, the petioles more or less reddish; panicles densely covered with stellate or chaff-like hairs; flowers white, very fragrant; stamens yellow; fruit fleshy, edible. In deep forests on the slopes of Mt. Cangrejal, at 180 and 330 meters altitude; also in ravine near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

GUTTIFERAE

CLUSIA L.

Clusia flava Jacq. Tree about 9 meters tall and 30 to 35 cm. in diameter; sap yellow and very adhesive. Leaves thick and more or less leathery; fruit opening star-shaped when ripe. In semi-arid woodland region near Coyoles.

Clusia mexicana Vesque. Tree about 7 meters tall. Leaves thick and somewhat fleshy; fruit subglobose, leathery. In deep forests on the slopes of Mt. Cangrejal, at 300 meters altitude.

Clusia utilis Blake. Tree about 6 meters tall. Leaves obovate, obtuse, thick and more or less leathery; flowers flesh-colored. In deep forests, slopes of Mt. Cangrejal, at 300 meters altitude.

SYMPHONIA L. f.

Symphonia globulifera L. f. Tree about 15 meters tall and 45 cm. in diameter. Buds and flowers bright red; tips of perianth

lobes black. A handsome and conspicuous tree when in flower. Frequent on the plains and lower slopes about La Ceiba.

BIXACEAE

BIXA L.

Bixa Orellana L. Small tree about 4.5 meters tall. Leaves ovate, attenuate-acuminate; capsule bristly; seeds red. In thickets on the foothills back of La Ceiba.

COCHLOSPERMACEAE

COCHLOSPERMUM Kunth

Cochlospermum vitifolium (Willd.) Spreng. Tree about 7 meters tall. Leaves palmately 5- or 7-lobed; fruit a large capsule; seeds covered with long, white hairs. In open forest back of Roma, about 25 kilometers east of La Ceiba.

VIOLACEAE

GLOEOSPERMUM Tr. & Planch.

Gloeospermum boreale Morton, sp. nov.—Arbor parva, ramulis griseis, teretibus, ca. 3 mm. diam., glaberrimis, lenticellis nullis; folia alterna, disticha, breviter petiolata, petiolo glabro, usque ad 8 mm. longo, supra valde canaliculato; lamina foliorum anguste oblonga, usque ad 18 cm. longa et 5.5 cm. lata, acuminata, basi obtusa vel rarius rotundata, remote dentata, chartacea, supra nitens, utrinque glaberrima, venis primariis subtus prominentibus, venulis reticulatis; inflorescentia axillaris, cymosa, semel vel raro bis furcata, vix 1 cm. longa, rhachibus et bracteolis parvis rotundis minute puberulis, pedicellis supra basin articulatis, ca. 6 mm. longis, glabris; sepala 5, flavescenti-viridia, basi connata, imbricata, orbicularia, rotundata, inaequalia, 2 exteriora minora, ca. 1.2 mm. longa et lata, 3 interiora ca. 1.7 mm. longa, omnia utrinque glabra, minute ciliolata; alabastra oblonga, acuta; petala flava, libera, imbricata, oblonga, ca. 6.5 mm. longa, 3 mm. lata, glabra; filamenta basi in tubum brevem integrum connata; antherae ca. 1 mm. longae, connectivo glabro, in appendicem albam, ca. 1 mm. longam, membranaceam, ovatam, terminalem producto; ovarium glabrum; bacca pyriformis, ca. 16 mm. longa et 14 mm. lata, glabra, laevis, stylo persistente coronata.—Honduras: Along the Danto River, near Mt. Cangrejal, Department of Atlántida, July 30, 1938, *T. G. Yuncker, J. M. Koeppe & K. A. Wagner* 8687 (type in U. S. National Herbarium, No. 1,746,851; duplicate in Herb. Field Mus.).

Gloeospermum is a genus new to North America, the six or seven previously known species being confined to Colombia, Peru, and Amazonian Brazil. Dr. H. Melchior has done much to clarify its status in three excellent papers (Revision der Gattung *Gloeospermum* Trian. & Planch., Notizbl. Bot. Gart. Berlin 8: 617–624. 1923; "Über die Zugehörigkeit von *Alsodeia andina* Tul. and *A. Gossypium* Tul. zur Gattung *Gloeospermum*," op. cit. 9: 56–59. 1924; "Über zwei neue Arten und die Morphologie der Blütenstände der Gattung *Gloeospermum* nebst einer systematischen Übersicht über die Gattung," op. cit. 9: 157–167. 1924). In the latter he keys seven species, one of which is dubious. Of these the one most nearly related to *G. boreale* seems to be *G. Ulei* Melch., from Rio Acre, Amazonas, Brazil, of which a specimen of the type collection (*Ule* 9622) is in the National Herbarium. This differs in having the calyx lobes strongly strigose on the back and rather obviously ciliate. The branchlets are puberulent, in contrast to the completely glabrous branches of *G. boreale*.

There is some doubt as to the proper reference of *G. Ulei* to *Gloeospermum*. According to Dr. A. Ducke, this species constitutes a distinct monotypic genus *Rinoreocarpus*, distinguished from *Gloeospermum* and related to *Rinorea* by having a three-valved, dehiscent capsule. In *G. boreale* I have been unable to see any evidence that the fruit is other than baccate, as in typical *Gloeospermum*. In drawing up a description of the flowers, only fairly well developed buds have been available, so the measurements given may not be found entirely accurate.

RINOREA Aubl.

Rinorea guatemalensis (Wats.) Bartlett. Shrub or small tree up to 6 meters tall. Flowers white, drooping; capsule 3-seeded. In forests on the slopes of Mt. Cangrejal, at 180 meters altitude; also on the ridge back of Roma, about 25 kilometers east of La Ceiba, at 150 to 240 meters altitude.

FLACOURTIACEAE

CARPOTROCHE Endl.

Carpotroche platyptera Pittier. Small tree about 6 meters tall. Leaves large; flowers small, greenish white; fruit about 3 cm. wide, with several thin, paper-like wings and numerous seeds, borne on the stem. In rocky ravine on the mountain slope near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

CASEARIA Jacq.

Casearia aculeata Jacq. Tree about 4.5 meters tall. Flowers greenish white; fruit with an orange and red aril. In thickets on the plains and lower mountain slopes about La Ceiba.

Casearia elegans Standl., sp. nov.—Frutex 1–1.5 m. altus, ramis gracilibus subteretibus ferrugineis lenticellis parvis pallidis conspersis, primo plus minusve puberulis vel pilosulis cito glabratis, internodiis brevibus; folia mediocria brevissime petiolata membranacea, petiolo usque 5 mm. longo; lamina oblongo-oblanceolata vel lanceolato-oblonga 10–14 cm. longa 3–5.5 cm. lata sensim vel subabrupte acuminata vel longiacuminata, basi acuta vel saepius basin versus sensim angustata, glabra, in toto margine serrata vel serrulata, apicibus dentium incurvis, sparse pellucido-lineata, in sicco laete viridis, costa subtus elevata gracili, nervis lateralibus utroque latere ca. 8 angulo lato saepe fere recto abeuntibus prominentibus irregularibus curvis, venis laxe reticulatis prominulis; flores axillares singuli vel paucifasciculati, pedicellis gracillimis 5–7 mm. longis (in statu fructifero ad 9 mm.) dense breviter pilosulis; sepala alba obovato-oblonga 7 mm. longa obtusa vel anguste rotundata tenuia extus dense minute puberula; stamina 6 sepalis bene breviora, filamentis filiformibus glabris, staminodiis filamentis duplo brevioribus linearibus dense albido-pilosis; ovarium glabrum; fructus ellipsoideus 2.5 cm. longus 1.4 cm. crassus, apice apiculatus, basi acutiusculus.—Honduras: Foothills back of La Ceiba, Dept. Atlántida, August 4, 1938, T. G. Yuncker, J. M. Koeppe & K. A. Wagner 8804 (type in Herb. Field Mus.); also No. 8606 from the same locality, growing in a thicket. In thicket, foothills, lower slopes of Mt. Cangrejal, No. 8605; fruit red when ripe.

An isolated species, outstanding because of the very large fruit and the unusually large flowers.

Casearia javitensis HBK. Shrub or small tree about 6 meters tall. Flowers very small, greenish white, numerous and clustered in the leaf axils; capsules red. On river banks back of La Ceiba.

Casearia mollifolia Standl., sp. nov.—Frutex vel arbuscula 1–4-metralis, ramulis tortuosis subteretibus brunneo-ferrugineis dense molliter patenti-pilosis, internodiis brevibus; folia mediocria brevissime petiolata tenuiter membranacea, petiolo vix ad 3 mm. longo dense piloso; lamina elliptica vel oblongo-elliptica, rare obovato-elliptica 5–9 cm. longa 3–5 cm. lata obtusa vel obtuse apicata, basi obtusa vel anguste rotundata, in toto margine inconspicue adpresso-crenata, dense pellucido-punctata, supra glabrata sed ad

nervos breviter pilosa sublucida, costa nervisque prominulis, subtus ubique dense breviter velutino-pilosa, costa gracili prominente, nervis lateralibus utroque latere ca. 9 angulo lato adscendentibus arcuatis irregularibus; inflorescentiae cymoso-corymbosae pauci- vel multiflorae breviter pedunculatae axillares densae vel sublaxae usque 2 cm. longae, floribus breviter vel longiuscule pedicellatis, pedicellis ut rami dense pilosis; sepala in sicco fusca obovata 3 mm. longa obtusa dense puberula; stamina 8; stigma capitatum; capsula immatura 5 mm. diam. subglobosa apice rotundata sparse pilosula vel fere glabra.—Honduras: In open forest near Medina, Dept. Yoro, in semi-arid region, alt. 170 meters, July 26, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8656 (type in Herb. Field Mus.). Also Nos. 8643 and 8641, from the same region.

This proposed species belongs to the poorly understood group of *Casearia nitida* (L.) Jacq., in which it is notable chiefly for the unusually abundant, soft pubescence covering most parts of the plant.

Casearia phegocarpa Standl., sp. nov.—Frutex vel arbor 2–6-metralis, trunco 7 cm. et ultra diam., ramis gracillimis teretibus brunnescentibus lenticellis parvis pallidis conspersis, novellis minute puberulis, internodiis brevibus; folia inter minora breviter petiolata firme membranacea, petiolo gracili 3–5 mm. longo minute puberulo; lamina oblanceolato-oblonga vel lanceolato-oblonga 7–11.5 cm. longa 2–3.3 cm. lata longe angustequae acuminata vel caudato-acuminata, acumine ipso obtuso, basi acuta vel subacuminata, interdum basin versus longe attenuata, in toto margine arcte serrulata, ubique dense pellucido-punctata, utrinque glabra vel glabrata, subtus in axillis nervorum sparse obscure barbata, costa subtus elevata gracili, nervis lateralibus utroque latere ca. 8 angulo latiusculo adscendentibus arcuatis prominentibus, venis vix manifestis; flores in cymas parvas paucifloras brevissime pedunculatas dispositi (non visi) pedicellati, sepalis ovalibus ciliatis; fructus glaber rubescens in sicco 10–12 mm. longus et fere aequilatus, parte centrali turgida, angulis anguste (ca. 2 mm. late) alato-productis, apice retusus.—Honduras: Lancetilla Valley, near Tela, Dept. Atlántida, alt. 20–600 meters, 1927–28, *Paul C. Standley* 55212 (type in Herb. Field Mus.); also Nos. 54558, 54054, 53221, 56697, 52749. Tela, thicket near the beach, *Standley* 54258. Lancetilla, *A. M. Chickering* 150. Near bank of Tela River above Lancetilla, *Yuncker* 4624. Along river at Lancetilla, *W. D. Hottle* 102. In thicket on river bank, foothills back of La Ceiba, *Yuncker, Koepper & Wagner* 8006. In forest, slopes of Mt. Cangrejal, 150 meters, *Yuncker, Koepper & Wagner* 8387.

The shrub or small tree here described is common along the Atlantic coast of Honduras, where it grows commonly in wet thickets at or near the margins of streams. It has been confused heretofore by the writer with *Casearia arborea* (Rich.) Urban, and was listed under that name in the *Flora of the Lencetilla Valley* (Field Mus. Bot. 10: 289. 1931). Material from British Honduras, Costa Rica, and Panama likewise referred to *C. arborea* is different from *C. phegocarpa*, and probably also from true *C. arborea*. The latter is a species of the West Indies and northern South America, differing from the Honduran plant in having the leaves covered beneath with a dense, pale tomentum.

HASSELLTIA HBK.

Hasseltia floribunda HBK. Small tree about 7 meters tall and 10 cm. in diameter. Leaves oval or elliptic-obovate, toothed, 3-nerved at the base; inflorescence panicle; capsule about 4 mm. in diameter, minutely and densely pubescent. In forests, foothills back of La Ceiba; also in semi-arid woodland region near Coyoles.

LAETIA Loebl.

Laetia Thamnia L. Tree about 6 meters tall. Leaves with pellucid dots and lines; fruit 3-celled, about 2 cm. in diameter, minutely and densely pubescent. In forests, slopes of Mt. Cangrejal, at 270 meters altitude.

LUNANIA Hook.

Lunania piperoides Standl. Tree about 7 meters tall. Leaves much resembling those of species of *Piper*; flowers greenish white, short-pedicellate, in branching, spike-like racemes. On the rocky ridge back of Roma, about 25 kilometers east of La Ceiba, at 240 meters altitude.

PROCKIA L.

Prockia crucis L. Shrub or small tree about 3 meters tall; leaves and young branches densely and finely pubescent. Flowers white; stamens numerous. In semi-arid upland, open forest near Las Flores, at 180 to 240 meters.

TURNERACEAE

ERBLICHIA Seem.

Erblichia odorata Seem. Tree about 6 meters tall and 20 to 25 cm. in diameter; wood very hard. Flowers numerous, about 6 cm. long and as wide when open, reddish orange, with pleasant odor.

The tree is exceptionally handsome when in full flower and would make an excellent ornamental. A few specimens were discovered on the banks of the Salado River, about 20 kilometers west of La Ceiba.

PASSIFLORACEAE

PASSIFLORA L.

Passiflora coriacea Juss. Herbaceous vine. Leaves much wider than long, leathery, peltate; flowers comparatively small, greenish. Climbing in thickets on the foothills back of La Ceiba.

Passiflora foetida L. Herbaceous vine, with a disagreeable odor. Densely hairy, with many of the hairs gland-tipped; floral bracts fimbriately dissected, with the divisions gland-tipped; flowers comparatively small, greenish. Climbing over herbs and low shrubs in waste places about La Ceiba.

Passiflora serratifolia L. Herbaceous vine. Leaves oval-oblong, drying comparatively thin; petioles with numerous glands; flowers 5 to 6 cm. wide, pale lavender, handsome; fruit up to 10 cm. long, yellow, edible. Common in thickets on the foothills back of La Ceiba.

CARICACEAE

CARICA L.

Carica Papaya L. Small tree about 2.5 meters tall. Occasionally escaped plants were found on the plains and lower foothills about La Ceiba.

LOASACEAE

GRONOVIA L.

Gronovia scandens L. Herbaceous vine with abundant pubescence, the hairs on the stem with terminal hooks. Leaves deeply and palmately 3- or 5-lobed; flowers in corymbose clusters opposite the leaves, yellowish green; calyx tube about the ovary, with wing-like projections. Climbing in thickets on the plains near La Ceiba.

BEGONIACEAE

BEGONIA L.

Begonia glabra Aubl. Herbaceous vine, scrambling over rocks and climbing in trees. Flowers greenish white. In deep forest along the Danto River on the slopes of Mt. Cangrejal, at 360 meters.

Begonia nicaraguensis Standl. Stems rather stout, up to 1 meter tall. Flower stalks up to 60 cm. tall, the clusters large; cap-

sule wings short and blunt. In thickets, slopes of Mt. Cangrejal back of La Ceiba; also on the rocky bank of a mountain stream, foothills near the village of Medina, at 190 meters altitude.

Begonia squarrosa Liebm. Low herb. Petioles with numerous reflexed, fimbriate scales; leaf vein axils often red; flowers white



FIG. 7. *Cereus Yunckeri*, a tree-like cactus growing in the semi-arid region of the Aguán River Valley above Olanchito.

or somewhat pink on the outside; capsule wings acute. On mossy rocks, banks of the Danto River on slopes of Mt. Cangrejal, at 360 meters altitude.

CACTACEAE

ACANTHOCEREUS Britt. & Rose

Acanthocereus pentagonus (L.) Britt. & Rose. Stems 3-angled or infrequently 4-angled, up to 6 meters long or more, scram-

bling in trees and over shrubs, strongly armed with rigid spines up to 2 cm. long. Common in semi-arid woodland region near Coyoles.

CEREUS L.

Cereus (*Lemaireocereus*) **Yunckeri** Standl., sp. nov.—Arbor usque ad 10 m. alta, trunco 35 cm. diam., ramis numerosis valde adscendentibus crassis ca. 9-costatis, costis late triangularibus acutiusculis, intervallis latis sed acutis; areolae parvae ca. 3 mm. latae atque 1 cm. distantes, tomento brevi pallide brunnescenti obtectae; aculeae subporrectae ca. 6 aciculares ochraceae vel fusco-griseae rigidae usque 1.5 cm. longae; flores fructusque non visi.—Honduras: In woodland, semi-arid region near Coyoles, Dept. Yoro, June 28, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8257 (type in Herb. Field Mus.).

This is presumably the same species that occurs also in the desert region of Comayagua, where the plants are conspicuous. The relationship is with **Cereus Eichlamii** (Britt. & Rose) Standl., comb. nov. (*Lemaireocereus Eichlamii* Britt. & Rose, *Cactaceae* 2: 89. f. 132. 1930), a common species of the more arid parts of Guatemala, to which, indeed, it may be too close for permanent specific segregation.

DEAMIA Britt. & Rose

Deamia testudo (Karw.) Britt. & Rose. Stems angled; spines rather soft. Flowers about 18 cm. long, handsome, white; stamens yellow. Climbing in trees in forests on the lower slopes of Mt. Cangrejal, at 150 meters altitude.

EPIPHYLLUM Haw.

Epiphyllum guatemalense Britt. & Rose. Epiphyte. Flowers white, 25 cm. long or more, rather showy. Common on trees on the lower slopes of Mt. Cangrejal back of La Ceiba; also in semi-arid woodland region about Coyoles.

Epiphyllum Pittieri (Weber) Britt. & Rose. Epiphytic. Flowers white. On trees in forests, foothills back of La Ceiba.

Epiphyllum stenopetalum (Foerst.) Britt. & Rose. Epiphytic. Buds red; flowers white. Pendent from branches of trees in the forest on the lower slopes of Mt. Cangrejal, at 150 meters altitude.

OPUNTIA Mill.

Opuntia hondurensis Standl., sp. nov.—Arbor vel arborescens, usque ad 9 m. alta, trunco ad 30 cm. diam., coma profuse ramosa densa; articuli pallide virides glabri obovati vel oblongo-obovati,

13–22 cm. longi 7 cm. lati et ultra crassi, areolis modice distantibus ca. 3 mm. diam.; aculeae in areola ca. 12 maxime inaequales graciles subteretes subferrugineae vel fusco-ferrugineae, longioribus 2–2.5 cm. longis divaricatis.—Honduras: In woodland, semi-arid region near Coyoles, Dept. Yoro, June 27, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8258 (type in Herb. Field Mus.).

Although the material and data at hand are but fragmentary, it seems worth while to assign a name to the tree *Opuntia* of the



FIG. 8. *Opuntia hondurensis*, a large plant, often tree-like, which occurs abundantly in the semi-arid region of the Aguán River Valley above Olanchito.

Aguán Valley, which presumably is the same as that of the Comayagua Desert of Honduras, and perhaps also as that of the Motagua Valley of Guatemala. Tree *Opuntias* form a conspicuous feature of the landscape in all these regions, although one will search in vain in Britton and Rose's account of the Cactaceae for mention of a tree *Opuntia* in Central America. The species here described is a true tree, with a massive, columnar trunk and a large, dense, rounded crown.

RHIPSALIS Gaertn.

Rhipsalis Cassutha Gaertn. Epiphytic. Stems slender, terete, forming large, pendent clusters; berries small, white, fleshy. On trees in forests on the lower slopes of Mt. Cangrejal.

Rhipsalis coriacea Polak. Epiphytic. Stems terete, the lateral branches flattened, up to about 2 cm. wide; berries small, white, fleshy. Pendent on trees, forests on the foothills of Mt. Cangrejal, back of La Ceiba.

SELENICEREUS Britt. & Rose

Selenicereus hondurensis (Schum.) Britt. & Rose. Vine. Stems rather slender, round, covered with numerous moderately soft spines. Scrambling over rocks and climbing in trees, semi-arid forest region near the village of Las Flores, at 285 meters altitude.

Selenicereus Macdonaldiae (Hook.) Britt. & Rose. Vine. Stem angled, almost spineless. Climbing in trees, forests on slopes of Mt. Cangrejal, at 240 meters altitude.

Selenicereus sp. Vine. Stems angled, almost spineless. Climbing trees, semi-arid woodland region near Coyoles.

Selenicereus sp. Vine. Stems angled, the spines comparatively soft. Climbing in trees, forests on the lower slopes of Mt. Cangrejal.

LYTHRACEAE

AMMANNIA L.

Ammannia coccinea Rottb. Herb 1 meter tall or less. Leaves opposite, sessile, clasping; flowers dark pink. Edge of irrigation canal near Coyoles.

CUPHEA Adans.

Cuphea hyssopifolia HBK. Small shrub 30 to 60 cm. tall. Leaves small, narrowly elliptic; flowers lavender. On rocky banks of the Danto River, lower slopes of Mt. Cangrejal back of La Ceiba.

LECYTHIDACEAE

ESCHWEILERA Mart.

Eschweilera hondurensis Standl., sp. nov.—Arbor 9-metralis, ramulis gracilibus fusco-ferrugineis, novellis ochraceis primo minute puberulis cito glabratis, internodiis brevibus; folia inter minora breviter petiolata papyracea, petiolo gracili 5–7 mm. longo supra late canaliculato; lamina anguste oblonga 9.5–14 cm. longa 3–4 cm. lata acuta vel subacuminata, apice ipso obtuso, basi rotundata vel obtusa, glabra, supra griseo-viridis vix lucida, costa gracili elevata, nervis venulisque prominulis, subtus concolor, costa elevata, nervis lateralibus utroque latere ca. 12 tenerrimis prominulis angulo fere recto divergentibus arcuatis, venulis prominulis arcte reticulatis;

pedicelli fructiferi incrassati ca. 1.5 cm. longi; pyxis coriaceo-lignescens turbinato-globosa 2.5 cm. lata, 2 cm. alta vel paullo ultra, dorso convexa, margine calycari orificio 5-7 mm. distante, dentium rudimentis in cristam transversam triangulari-lobatam extensis; operculum rotundato-convexum apice crasse breviter umbonatum.—Honduras: Bank of stream, lower slopes of Mt. Cangrejal, near La Ceiba, Dept. Atlántida, August 6, 1938, *T.G. Yuncker, J. M. Koepper & K. A. Wagner* 8829 (type in Herb. Field Mus.).

This is the northernmost species of *Eschweilera* that has been discovered.

COMBRETACEAE

COMBRETUM L.

Combretum Cacoucia Exell. Stout, woody vine, the young growth densely brown-pubescent. Flowers large, red, in terminal, bracteate racemes; bracts large, lanceolate. Climbing in thickets on the banks of the Salado River, about 20 kilometers west of La Ceiba.

Combretum mexicanum H. & B. Large, woody vine. Leaves oblong or oval-obovate, abruptly pointed. Flowers small, white, in large, branching, terminal or axillary clusters; fruit greenish red, 4-winged or angled. In thickets on slopes of Mt. Cangrejal back of La Ceiba; also on the Salado River, about 20 kilometers west of La Ceiba; and in semi-arid woodland region near Coyoles.

TERMINALIA L.

Terminalia Catappa L. Tree 12 meters tall; branches arranged in definite and characteristic whorls. Leaves large, obovate, pinnately nerved; flowers small, white, in long, spike-like clusters; fruit compressed, two-edged, drupe-like, with thin, reddish flesh, edible. Planted about dwellings and common on the plains about La Ceiba.

MYRTACEAE

EUGENIA L.

Eugenia axillaris (Swartz) DC. Tree about 7 meters tall. Fruit at first yellow, finally black, about 1 cm. in diameter, fleshy. Frequent on the slopes of Mt. Cangrejal back of La Ceiba.

Eugenia ceibensis Standl., sp. nov.—Frutex 2.5 m. altus, ramis gracilibus teretibus ochraceis minute puberulis vel glabratiss, internodiis 4-6 cm. longis; folia mediocria breviter petiolata chartacea, petiolo gracili 6-8 mm. longo minute puberulo vel glabrato;

lamina late elliptica vel ovato-elliptica 8.5–12.5 cm. longa 5–7 cm. lata subabrupte acuminata, acumine ipso obtuso, basi late cuneato-obtusa, glabra, supra in sicco laete viridis, costa subimpressa, nervis teneris prominentibus, subtus paullo pallidior, costa gracili prominente, nervis lateralibus utroque latere ca. 10 teneris angulo lato adscendentibus fere rectis, venis teneris laxe reticulatis, costa prope basin laminae minute tuberculata; inflorescentiae axillares brevissime racemosae petiolo vix longiores 2–5-florae, rhachi minute puberula, pedicellis usque 4 mm. longis glabris, bracteolis rotundatis 1.5 mm. longis; sepala rotundata 2 mm. longa punctata, petalis albis sepalis longioribus.—Honduras: In thicket, foothills back of La Ceiba, Dept. Atlántida, July 8, 1938, *T. G. Yuncker, J. M. Koepfer & K. A. Wagner* 8309 (type in Herb. Field Mus.).

Somewhat resembling the genus *Malpighia* in its foliage, noteworthy for the rather large and, when dried, bright green leaves, and for the small inflorescences.

Eugenia coyolensis Standl., sp. nov.—Arbor 4.5 m. alta, ramis gracillimis teretibus pallidis subteretibus ut videtur glabris, internodiis plerumque brevibus; folia inter minora brevissime petiolata subcoriacea, petiolo crassiusculo 2–4 mm. longo glabro; lamina oblonga vel obovato-oblonga 4–6.5 cm. longa 2.5–3 cm. lata apice rotundata vel late obtusa, basi cuneata, glabra, supra viridis, costa subimpressa, nervis venisque vix obviis, subtus multo pallidior, costa elevata, nervis lateralibus utroque latere ca. 9 vix prominulis fere rectis angulo semirecto adscendentibus, nervis obsoletis, pagina inferiore minute nigro-punctata, margine saepe subrevoluta; flores axillares fasciculati pauci, in axillo 1–3, pedicellis 6–8 mm. longis sericeis rectis vel recurvis, bracteolis ovatis obtusis 1.5 mm. longis adpressis; hypanthium sericeum, sepalis subrotundatis 3 mm. longis apice rotundatis ciliolatis atque sparse sericeis viridescentibus punctatis.—Honduras: In semi-arid woodland near Coyoles, Aguán River Valley, Dept. Yoro, June 28, 1938, *T. G. Yuncker, J. M. Koepfer & K. A. Wagner* 8069 (type in Herb. Field Mus.).

The trunk is described as 10 cm. in diameter, the bark as light gray in color.

Eugenia Jambos L. Tree about 9 meters tall. Leaves elliptic-lanceolate, acuminate, somewhat leathery; flowers large, white; fruit fleshy, edible. In forests on the slopes of Mt. Cangrejal, at 150 meters altitude.

Eugenia Koepferi Standl., sp. nov.—Arbor 6–9-metralis, ramulis teretibus griseis vel brunnescentibus, novellis minute brun-

nescenti-sericeis, internodiis brevibus vel elongatis; folia majuscula breviter petiolata subcoriacea, petiolo 4–8 mm. longo crassiusculo minute sericeo vel glabrato; lamina elliptico-oblonga 10–15 cm. longa 4–7 cm. lata acuminata ad late obtusa, apice ipso vulgo obtuso, basi acuta, supra viridis glabra, costa impressa, nervis venisque obsoletis, subtus brunnescens, ubique minute dense sericea, costa gracili elevata, nervis lateralibus utroque latere ca. 13 angulo semirecto adscendentibus tenerrimis obscuris fere rectis; flores axillares brevissime racemosi vel subfasciculati pauci, inflorescentiis petiolis vix longioribus, pedicellis crassiusculis usque 9 mm. longis dense minute brunneo-sericeis, bracteolis rotundato-ovatis obtusis 1.5 mm. longis; calyx minute dense brunneo-sericeus, sepalis suborbicularibus 2.5 mm. longis apice rotundatis punctatis.—Honduras: In forest, slope of Mt. Cangrejal, near La Ceiba, Dept. Atlántida, alt. 180 meters, July 12, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8400 (type in Herb. Field Mus.). In deep forest along Danto River, slopes of Mt. Cangrejal, 360 meters, No. 8749 of the same collectors. Guarunta, Wisperini Camp, Dept. Colón, 22–30 meters, February, 1938, *Christine & Wolfgang von Hagen* 1336.

Eugenia tapirorum Standl., sp. nov.—Arbor 7.5 m. alta ut videtur omnino glabra, ramulis gracilibus teretibus, internodiis brevibus; folia parva breviter petiolata subcoriacea, petiolo 4–5 mm. longo; lamina obovato-oblonga vel oblongo-elliptica 3–5 cm. longa 1–2.2 cm. lata, apice subito breviter cuspidato-acuminata, acumine brevi obtuso, basi anguste vel late cuneato-angustata, supra viridis sublucida, costa impressa, nervis venisque obscuris, subtus paullo pallidior, costa gracili elevata, nervis lateralibus utroque latere ca. 10 tenerrimis obscuris angulo latiusculo adscendentibus fere rectis prope marginem in nervum collectivum conjunctis; flores axillares fasciculati pauci, pedicellis fructiferis crassiusculis usque 5 mm. longis; fructus globosus 9–12 mm. diam. densissime minute glanduloso-tuberculatus.—Honduras: In deep forest along Río Danto, slopes of Mt. Cangrejal, La Ceiba, Dept. Atlántida, alt. 360 meters, July 30, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8700 (type in Herb. Field Mus.).

The foliage resembles somewhat that of *Ficus nitida* Thunb.

MYRCIA DC.

Myrcia Oerstediana Berg. Tree about 5.5 meters tall. Flowers small, white. In forests on the foothills of Mt. Cangrejal, back of La Ceiba.

PSIDIUM L.

Psidium Guajava L. Shrub or small tree about 3.5 meters tall; bark smooth, mottled. Corolla white; fruit the size and color of a small lemon, edible and used in making jelly. Common about La Ceiba.

MELASTOMACEAE

CLIDEMIA Don

Clidemia dentata Don. Shrub about 2 meters tall. Flowers pink; fruit red. In thickets on the lower slopes of Mt. Cangrejal.

CONOSTEGIA Don

Conostegia hondurensis Standl., sp. nov.—Frutex 2-metralis, ramis gracilibus pilis longis apice breviter stellatis dense hirsutis, serius glabratis, internodiis elongatis; folia mediocria petiolata membranacea, petiolo 1–3.5 cm. longo ut rami stellato-piloso; lamina oblongo-elliptica usque ad 19 cm. longa atque 9 cm. lata vel ultra, subabrupte angustequae longiacuminata, basi acuta vel obtusa, supra ubique sat dense hispidula, ad nervos stellato-pilosa, subtus sat dense ubique pilis fulvis apice stellatis breviter hirsuta, prope basin quintuplinervia, margine integro vel paullo undulato; inflorescentia terminalis 1.5 cm. longe pedunculata ca. 5.5 cm. longa et aequilata laxae pauciflora, floribus longipedicellatis, ramis dense pilis apice stellatis hirsutis; fructus juvenilis subglobosus 4 mm. diam. sparse pilis patentibus apice stellatis hirsutus; cetera ignota.—Honduras: Bank of Río Danto, slopes of Mt. Cangrejal, near La Ceiba, Dept. Atlántida, alt. 300 meters, August 6, 1938, T.G. Yuncker, J. M. Koepfer & K. A. Wagner 8818 (type in Herb. Field Mus.).

The single specimen at hand is in young fruit, and the character of the young calyx therefore not observable. The plant, however, is clearly a *Conostegia*, and I have been unable to associate it with any species recorded for Central America. Most noteworthy is the abundant pubescence of tawny or brownish, spreading hairs, each with a stelliform tuft of short branches at the apex.

Conostegia xalapensis (Bonpl.) Don. Shrub or small tree about 2.5 meters tall. Leaves green above, densely buff-tomentose beneath; flowers pink; fruit dark purple. In thickets, foothills back of La Ceiba.

MICONIA R. & P.

Miconia angustispica Blake. Shrub or small tree about 3.5 meters tall. Leaves large, up to 30 cm. long or more, 3-nerved;

flowers in long, interrupted, spike-like clusters. In ravine, slope near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters.

Miconia dodecandra (Desr.) Cogn. A tree about 5.5 meters high; corolla gray, scurfy. On low bank of Río Salado, near Salado.

Miconia hondurensis D. Sm. Tree about 9 meters tall. Leaves 3-nerved, dark green above, light green beneath; fruit nearly black. In deep forest on the slopes of Mt. Cangrejal, at 300 meters altitude.

Miconia hyperprasina Naud. Small tree or shrub about 3.5 meters tall. Flowers in terminal, panicle clusters, the pedicels and peduncles red; fruit blue. In thickets, foothills back of La Ceiba.

Miconia impetiolearis (Swartz) Don. Shrub about 3 meters tall. Leaves up to 30 cm. long, obovate, sessile; flowers small, white, in large, terminal, panicle clusters; fruit red. In forests on the lower slopes of Mt. Cangrejal.

Miconia longifolia DC. Small tree about 4.5 meters tall. Flowers in large, terminal, panicle clusters, the branches of the inflorescence red; fruit purple. In deep forest along the Danto River, slopes of Mt. Cangrejal, at 300 meters altitude.

Miconia Schlimii Triana. Tree up to 10 meters tall. Flowers white, in comparatively small, panicle clusters. Young stems, petioles, peduncles, and fruit rusty-brown-pubescent. In forests, slopes of Mt. Cangrejal, at 330 meters altitude; also in a deep ravine on a slope near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

MOURIRIA Aubl.

Mouriria parvifolia Benth. Shrub or small tree about 4.5 meters tall. Leaves ovate-lanceolate, sessile. Flowers and fruit axillary. In forest on the mountain ridge back of Roma, about 25 kilometers east of La Ceiba, at 300 meters altitude.

OSSAEA DC.

Ossaea trichocalyx Pittier. Shrub about 2 meters tall. Leaves elliptic-lanceolate, decurrent at the base, the apex sharply acuminate; fruit bright red. On mountain slope near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

ONAGRACEAE

JUSSIAEA L.

Jussiaea erecta L. Herb about 60 cm. tall. Flowers yellow. In swamps near the seashore, vicinity of La Ceiba.

Jussiaea repens L. var. **peploides** (HBK.) Griseb. Stems fleshy, long, prostrate. Flowers yellow. Creeping in mud and extending out on surface of pools along the Aguán River, near Coyoles.

Jussiaea suffruticosa L. Suffruticose, about 1 meter high. Flowers yellow. Frequent in sandy soil about La Ceiba.

ARALIACEAE

GILIBERTIA R. & P.

Gilibertia arborea (L.) March. Small, glabrous tree up to 7 meters tall. Leaves oval, abruptly acute, up to 18 cm. long, long-petiolate; flowers green, in small umbels which are arranged in a racemose cluster; fruit greenish white. Frequent on the foothills and slopes of Mt. Cangrejal, up to 300 meters altitude. No. 8682 represents a curious, abnormal form of the species, notable for its sessile rather than pedicellate flowers.

ERICACEAE

ANDROMEDA L.

Andromeda mexicana Hemsl. Small tree about 4.5 meters tall and 5 cm. in diameter. Leaves elliptic-lanceolate, acute, somewhat leathery; flowers in axillary clusters. In open forest on rocky mountain slope above the village of Las Flores, at 330 meters altitude.

MYRSINACEAE

ARDISIA Swartz

Ardisia amplifolia Standl. Small tree about 3 meters tall. Flowers yellow, in small umbels which are arranged in paniculate clusters; branches of the flower clusters bright red; fruit red to black. In forests, foothills and slopes of Mt. Cangrejal.

Ardisia compressa HBK. Small, glabrous tree about 3 meters tall. Flowers white, in open, paniculate clusters; branches of the inflorescence bright red; fruit bright red. In forests, lower slopes of Mt. Cangrejal.

Ardisia paschalis D. Sm. Shrub or small tree up to 6 meters tall. Leaves more or less leathery; flowers in branching, racemose clusters; corolla white to pink. Frequent in the semi-arid woodland region about Coyoles.

Ardisia pellucida Oerst. A low shrub less than 1 meter tall. Leaves large, finely and unevenly serrate with spreading teeth;

flowers in dense, corymbose clusters; fruit bluish. In thickets along stream banks on lower slopes of Mt. Cangrejal.

SAPOTACEAE

CALOCARPUM Pierre

Calocarpum mammosum (L.) Pierre. Fine, large tree about 18 meters tall and 1 meter in diameter, with very adhesive latex. Leaves large, obovate, pinnately nerved; flowers sessile, numerous along the branches; fruit subglobose, brown-scurfy, edible. In forests, lower slopes of Mt. Cangrejal.

LUCUMA Molina

Lucuma campechiana HBK. Tree about 9 meters tall. Leaves large, elliptic-oblongate; fruit brown, scurfy. In forests, slopes of Mt. Cangrejal, at 330 meters altitude.

LOGANIACEAE

POLYPREMUM L.

Polypremum procumbens L. Low, weedy herb. Flowers very small, greenish white, axillary. On sand bars in the Aguán River, near Coyoles.

SPIGELIA L.

Spigelia Humboldtiana Cham. & Schlecht. Herb up to 60 cm. tall. Flowers white. Occasional in thickets on the lower slopes of Mt. Cangrejal.

APOCYNACEAE

ECHITES Jacq.

Echites turrigera Woodson. Woody, glabrous vine. Leaves oblong-ovate, sharply acute; flowers white. Climbing in trees in semi-arid woodland near Coyoles.

FORSTERONIA Meyer

Forsteronia myriantha D. Sm. Large, glabrous, woody vine, with milky, very adhesive sap. Flowers yellowish; fruit long and slender. Climbing in trees in forests on the lower slopes of Mt. Cangrejal.

Forsteronia spicata (Jacq.) Mey. Shrub or small tree about 3 meters tall. Leaves 10 to 12 cm. long, oval, abruptly acute, densely

and finely pubescent; flowers small, in compact, paniculate spikes. In open, semi-arid woodland region near Las Flores.

MALOUETIA A. DC.

Malouetia guatemalensis (Muell. Arg.) Standl. Small tree up to 9 meters tall; sap abundant, milky. Flowers small, creamy white, in axillary clusters; follicles large, slender. Frequent in forests on the slopes of Mt. Cangrejal, up to 330 meters altitude; also on the ridge back of Roma, about 25 kilometers east of La Ceiba, at 240 meters altitude.

MESECHITES Muell. Arg.

Mesechites trifida (Jacq.) Muell. Arg. Slender, woody vine. Leaves opposite, oval-oblong, acute; follicles 30 cm. long or more, slender; seeds with a tuft of tawny hairs. Climbing in thickets at edge of forest, lower slopes of Mt. Cangrejal.

PLUMERIA L.

Plumeria rubra L. Tree about 10 meters tall; latex milky, abundant; young growth soft and somewhat succulent; older wood very brittle. Leaves large, oblong-elliptic, pinnately nerved, acute; flowers large, showy, white, in large, open, paniculate clusters. In semi-arid woodland region near Coyoles.

PLUMERIOPSIS Rusby & Woodson

Plumeriopsis Ahouai (L.) Rusby & Woodson. Tree about 15 feet tall; leaves obovate; latex white; fruit bright red. In deep forest on the lower slopes of Mt. Cangrejal.

RAUWOLFIA L.

Rauwolfia hirsuta Jacq. Shrub or small tree up to 3.5 meters tall. Leaves and young growth minutely pubescent; flowers small, greenish, in small, cymose clusters; berries red to black. In semi-arid region about Coyoles.

RHABDADENIA Muell. Arg.

Rhabdadenia biflora (Jacq.) Muell. Arg. Woody, glabrous vine. Leaves oblong, opposite, abruptly and sharply pointed; flowers white, in few-flowered, racemose clusters. In sandy soil, thickets near the seashore, vicinity of La Ceiba.

TABERNAEMONTANA L.

Tabernaemontana citrifolia L. Tree about 9 meters tall and 35 cm. in diameter; latex abundant, milky. Flowers creamy white, in cymose clusters; fruits in pairs, divergent, fleshy, pod-like. Frequent in forests on the lower slopes of Mt. Cangrejal.

ASCLEPIADACEAE

ASCLEPIAS L.

Asclepias curassavica L. Herb 60 to 90 cm. tall. Flowers showy, the corolla dark red, the honey horns bright yellow. A frequent weed in open places on the plains and lower slopes about La Ceiba.

FUNASTRUM Fourn.

Funastrum clausum (Jacq.) Schlechter. Herbaceous vine, with slender stems up to 6 meters long or more; sap abundant, milky. Leaves linear-lanceolate, few. Trailing on sandbars in the Aguán River, near Coyoles.

CONVOLVULACEAE

IPOMOEA L.

Ipomoea Pes-caprae (L.) Roth. Smooth, trailing, herbaceous vine. Flowers pinkish purple. Common on sandy beaches near La Ceiba.

Ipomoea stolonifera (Cyrill.) Poir. Smooth, trailing herb. Leaves somewhat fleshy; flowers white. In sand, along ocean beach near Salado, about 20 kilometers west of La Ceiba.

Ipomoea tiliacea (Willd.) Choisy. Herbaceous vine. Flowers purplish. Climbing in thickets near Roma, about 25 kilometers east of La Ceiba.

LYSIOSTYLES Benth.

Lysiostyles sericea Standl. Woody vine. Leaves densely covered beneath with silky hairs; flowers small, greenish. Climbing in thickets on the slopes of Mt. Cangrejal, at 180 meters altitude.

MARIPA Aubl.

Maripa nicaraguensis Hemsl. Large, woody vine. Fruit orange-yellow. In thickets along the Danto River, foothills of Mt. Cangrejal.

QUAMOCLIT Moench

Quamoclit pennata (Desr.) Bojer. Smooth, herbaceous vine. Leaves deeply pinnate-divided, the lobes linear; corolla bright red. Climbing over herbs on sandbars in the Cangrejál River, back of La Ceiba.

BORAGINACEAE

BEURERIA Jacq.

Beureria Wagneri Standl., sp. nov.—Arbor 4.5–7.5 m. alta, ramulis gracilibus subteretibus vel plus minusve compressis cinnamomeis, novellis sparse vel dense laxaque pilosis, internodiis brevibus; folia mediocria breviter petiolata crasse membranacea, petiolo gracili 10–12 mm. longo hirtello; lamina elliptico-oblonga ad vel paullo supra medium latissima acuta vel breviter acuminata, basi acuta, in sicco saepius fusca, supra sublucida ad nervos sparse hirtella vel fere omnino glabra puncticulata, subtus concolor ad costam nervosque sparse hirtella vel fere glabra, costa gracili elevata, nervis lateralibus utroque latere ca. 7 prominentibus angulo latiusculo adscendentibus arcuatis, venulis vix prominulis laxe reticulatis; inflorescentia laxa multiflora breviter vel longiuscule pedunculata usque 5 cm. longa, ramis gracilibus dense albido-hirtellis, floribus in cymas laxas vel subdensas paucifloras dispositis, pedicellis vix ultra 2 mm. longis; calyx anguste campanulatus dense breviter patenti-hirtellus 5 mm. longus superne 3 mm. latus profunde inaequaliter lobatus, lobis ovatis acutis erectis intus sericeis; corolla alba glabra, tubo non exserto 6–7 mm. longo, lobis ovalibus apice rotundatis patentibus aequilongis; stamina longiexserta, antheris linearibus 2.5 mm. longis; fructus ovoideo-globosus glaber 7 mm. diam.—Honduras: In forest, foothills back of La Ceiba, Dept. Atlántida, July 23, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8608 (type in Herb. Field Mus.). Also Nos. 8261 and 8217 from the same locality.

In general appearance as well as in most details this Honduran tree is similar to *B. oxyphylla* Standl., of British Honduras. That lacks the pubescence characteristic of *B. Wagneri*, which is most abundant and persistent upon the inflorescence.

CORDIA L.

Cordia bicolor A. DC. Tree about 7 meters tall and 20 cm. in diameter. Leaves large, oval-oblong, rough, acute, pinnate-nerved; flowers small, in open, paniculate clusters; fruit semi-fleshy. In forests on the lower slopes of Mt. Cangrejál.

Cordia ferruginea (Lam.) R. & S. Shrub about 1 meter tall. Leaves rough; flowers small, greenish white, in spike-like clusters. Common on river bars and foothills back of La Ceiba.

Cordia globosa (Jacq.) HBK. Small shrub about 60 cm. tall. Leaves oval-ovate, about 5 cm. long, pubescent beneath, bristly-scabrous above; flowers small, in globose, head-like clusters. In open, upland, grazing land near the village of Medina, at 180 meters altitude.

Cordia nitida Vahl. Tree about 7 meters tall. Flowers cream-colored, comparatively small, in open, paniculately cymose clusters. Margins of the Danto River, foothills above La Ceiba.

HELIOTROPIUM L.

Heliotropium angiospermum Murr. Weedy herb, about 1 meter tall or less. Flowers white. In sandy soil, waste areas in semi-arid regions about Coyoles.

Heliotropium transalpinum Vell. Weedy herb, about 1 meter tall. Flowers greenish white. In semi-arid woodland region about Coyoles.

TOURNEFORTIA L.

Tournefortia bicolor Swartz. Woody vine. Flowers small, white, in spreading, paniculately cymose clusters; fruit white, fleshy. In forest along the Danto River, slopes of Mt. Cangrejal, at 150 meters altitude.

Tournefortia cuspidata HBK. Woody vine. Young growth, leaves, and inflorescence densely covered with long, erect, brown hairs; leaves elliptic, acuminate; flowers white, in cymose clusters; fruit white. In thickets, margin of Danto River, lower slopes of Mt. Cangrejal.

VERBENACEAE

AEGIPHILA Jacq.

Aegiphila elata Swartz. Scandent shrub. Corolla yellowish white. In thickets on the foothills back of La Ceiba.

CORNUTIA L.

Cornutia grandifolia (Schlecht. & Cham.) Schauer. Small tree about 2.5 meters tall, the branches strongly 4-angled. Leaves densely hairy; flowers violet. In thickets on the foothills back of La Ceiba.

LANTANA L.

Lantana glandulosissima Hayek. Shrub about 1 to 2 meters tall, the stems armed with recurved prickles. Flowers varying from yellow to orange; fruit black. In sandy, alluvial soil near the Aguán River below Coyoles.

Lantana trifolia L. Shrub about 1 meter tall. Flowers varying in color from white or pinkish to violet. In old pastures near the Cangrejal River, foothills back of La Ceiba; also common in semi-arid upland in open areas about the village of Las Flores, at 180 to 300 meters altitude.

PHYLA Lour.

Phyla cuneifolia (Torr.) Greene. Low, creeping herb. Leaves oblong, cuneate, sparingly toothed about the apex; flowers white, in somewhat elongate spikes. On sandbars in the Aguán River, near Coyoles.

Phyla nodiflora var. **reptans** (HBK.) Moldenke. Low, creeping herb. Leaves coarsely toothed; flowers white, in very short, spike-like clusters. In thickets along the Aguán River near Coyoles.

PRIVA Adans.

Priva lappulacea (L.) Pers. Low herb. Flowers pale lavender to purple, in slender, racemose clusters. In thickets along the Aguán River near Coyoles.

STACHYTARPHETA Vahl

Stachytarpheta jamaicensis (L.) Vahl. Herb about 60 cm. tall. Flowers purplish, in stout, spike-like clusters. In sand near the seashore, vicinity of La Ceiba.

VITEX L.

Vitex Gaumeri Greenm. Tree about 15 meters tall and 35 cm. in diameter. Leaves palmately compound, the leaflets densely hairy beneath, entire; flowers small, deep blue, with pleasant odor, in panicle clusters. In open forests on semi-arid highland near the village of Las Flores, at 180 meters altitude.

Vitex Kuylenii Standl. Small tree about 4.5 meters tall. Leaves palmately compound, the leaflets glabrous; flowers blue, in panicle clusters. In forests, foothills of Mt. Cangrejal, back of La Ceiba.

LABIATAE

OCIMUM L.

Ocimum micranthum Willd. Weedy herb about 30 cm. tall. Flowers blue. Abundant in upland grazing land near the village of Medina.

TEUCRIUM L.

Teucrium vesicarium Mill. Herb up to 1 meter tall. Flowers white. On banks of irrigation canal, near Coyoles.

SOLANACEAE

CESTRUM L.

Cestrum nocturnum L. Tree about 6 meters tall. Leaves oval-oblong or subovate, sharply acute, entire; flowers greenish, in axillary, racemose clusters. At edge of the forest on the foothills of Mt. Cangrejal, back of La Ceiba.

CYPHOMANDRA Sendtn.

Cyphomandra costaricensis D. Sm. Shrub or small tree about 4.5 meters tall. Leaves broadly ovate, somewhat hirtellous beneath, entire, deeply cordate; fruit about 3 cm. long, ovoid, berry-like. Near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

JUANULLOA R. & P.

Juanulloa mexicana (Schl.) Miers. Stout, woody vine. Leaves oval-obovate, smooth above, densely tomentose beneath with branching hairs; flowers deep orange. Climbing in trees in forests on the slopes of Mt. Cangrejal, at 240 meters altitude.

LYCIANTHES Hassler

Lycianthes heteroclita (Sendtn.) Bitter. Shrub or small tree about 3 meters tall. Leaves large, elliptic, acuminate, drying thin; flowers pale lavender, in axillary clusters. In deep forest along the Danto River, slopes of Mt. Cangrejal, at 300 meters altitude.

Lycianthes lenta (Cav.) Bitter. Shrub or small tree up to 7 meters tall, somewhat scandent. Leaves oval-ovate, acute. Leaves and branches densely pubescent with branching hairs; flowers lavender or purple, in axillary clusters; berries yellow or red. In open forest on rocky mountain slope above Roma, about 25 kilo-

meters east of La Ceiba, at 150 meters altitude; also on the foothills back of La Ceiba.

Lycianthes nitida Bitter. Scandent shrub. Leaves large, elliptic, acute, the base oblique; flowers orange, in axillary clusters. Climbing in trees, forest near the Danto River on the slopes of Mt. Cangrejal, at 240 meters altitude.

Lycianthes quichensis (Coult. & D. Sm.) Bitter. Herbaceous, one meter tall or less. Flowers white, solitary in the leaf axils, on very long pedicels. In sandy soil near the Cangrejal River, foothills back of La Ceiba.

Lycianthes vulpina Standl. Scandent shrub about 3 meters tall. Flowers white, axillary; calyx with slender, filiform, hairy appendages; fruit orange. Stems, leaves, etc. densely hairy, with long, brown, branching hairs. In deep forest near the Danto River on the slopes of Mt. Cangrejal, at 360 meters altitude.

MARKEA L. Rich.

Markea neurantha D. Sm. Tree about 7 meters tall. Leaves alternate, large, elliptic, acute; petioles purple; flowers greenish purple, about 5 cm. long, in racemose clusters at the end of a peduncle 60 cm. long or more. On rocky bank of the Danto River, slopes of Mt. Cangrejal.

PHYSALIS L.

Physalis Lagascae R. & S. Weedy herb. Corolla yellow with brown throat. In waste places about La Ceiba.

SOLANUM L.

Solanum Donnell-Smithii Coult. Woody vine, covered with erect, apically branched hairs and armed with recurved prickles. Leaves with prickles on the midrib and covered with stellate hairs; fruit orange-red. Climbing in trees and shrubs at the edge of the forest, foothills back of La Ceiba.

Solanum nudum HBK. Shrub or small tree 2 to 3 meters tall, glabrous. Leaves elliptic, acute, glabrous; flowers white, in umbellate, lateral clusters; berries black. Common in thickets on the foothills back of La Ceiba; also near the Aguán River, vicinity of Coyoles.

Solanum ochraceo-ferrugineum (Dunal) Fernald. Shrub or small tree about 4.5 meters tall and 5 cm. in diameter. Young

growth and leaves densely covered with stellate hairs; flowers white. In sandy soil in thickets along the Aguán River near Coyoles.

Solanum umbellatum Mill. Shrub or small tree about 6 meters tall. Young growth and leaves densely covered with stalked, stellate hairs; flowers white, in compact, cymose clusters; fruit yellow. In sandy soil, thickets along the Aguán River near Coyoles; also in the foothills back of La Ceiba.

Solanum unguis-cati Standl. Woody vine. Leaves entire or variously lobed. Both leaves and stems armed with recurved prickles; flowers blue, in cymose clusters. Climbing in thickets in semi-arid woodland region near Coyoles.

Solanum verbascifolium L. Shrub or small tree about 3.5 meters tall. Leaves and young growth very densely covered with stalked, stellate hairs; flowers white, in cymose clusters; fruit yellow. In open forests on the ridge back of Roma, about 25 kilometers east of La Ceiba, at 240 meters altitude.

SCROPHULARIACEAE

RUSSELIA Jacq.

Russelia sarmentosa Jacq. Low, half-woody shrub, the stems square in cross section. Leaves opposite, subsessile, ovate, crenate, sparingly pubescent; flowers bright red, in axillary clusters. In semi-arid woodland region near Coyoles.

Russelia verticillata HBK. Herb about 1 meter tall, the stems angled. Leaves opposite or whorled, on very short petioles, ovate-lanceolate, serrate, acuminate; flowers scarlet, in axillary clusters. On a rocky cliff along the Danto River, slopes of Mt. Cangrejal back of La Ceiba.

SCOPARIA L.

Scoparia dulcis L. Low, partially woody herb or shrub. Flowers small, white, solitary or in umbellate, axillary clusters. In sandy soil in thickets near the Aguán River, near Coyoles.

TETTRANEMA Benth.

Tetranema mexicanum Benth. Herb about 30 cm. tall. Leaves 10 to 15 cm. long, spatulate, sparingly pubescent, clustered near the top of the stem; flowers violet with purple throat, in few-flowered, cymose clusters on very long, axillary peduncles. On a steep, rocky cliff along the Danto River, slopes of Mt. Cangrejal, at 300 meters altitude. Rare.

BIGNONIACEAE

AMPHITECNA Miers

Amphitecna macrophylla (Seem.) Miers. Tree about 8 meters tall. Flowers white, showy, borne along the trunk. In deep forest on the slopes of Mt. Cangrejal, at about 240 meters altitude. This is believed to be the first record of this species for Honduras.

CLYTOSTOMA Miers

Clytostoma ocositense (D. Sm.) Seibert. Woody vine. Fruit large, covered with spines. Climbing in thicket near La Ceiba.

CYDISTA Miers

Cydista diversifolia (HBK.) Miers. Woody vine. Leaves compound, the leaflets 2, ovate, cordate, acuminate; flowers purplish, 2 to 3 cm. long, showy, in pedunculate, axillary, branching clusters. Climbing in thickets along streams in semi-arid upland near the village of Medina, at 180 meters altitude.

Cydista potosina (Schum. & Loes.) Loes. Large, woody vine. Leaflets 2; flowers 3 to 4 cm. long, white or buff with a purplish or reddish throat, showy. In thickets, foothills back of La Ceiba; also at edge of stream, mountain slope near the village of Las Flores, at 285 meters altitude.

ENALLAGMA Baill.

Enallagma latifolia (Mill.) Small. Tree about 7 meters tall. Leaves oval to obovate, drying firm; fruit globose, about 8 cm. in diameter. In forest on rocky ridge back of Roma, about 25 kilometers east of La Ceiba, at 300 meters altitude.

MARTINELLA Baill.

Martinella verrucosa (Standl.) Standl. Woody vine. Leaves compound, the leaflets 2, large, oval; flowers 4 to 6 cm. long, red or pink, handsome, in branching, axillary clusters. In thickets, margin of the Danto River on the slopes of Mt. Cangrejal.

PARAGONIA Bur.

Paragonia pyramidata (Rich.) Bur. Woody vine. Pods 30 cm. long or more. Climbing in trees, thickets in the foothills back of La Ceiba.

GESNERIACEAE

ACHIMENES P. Br.

Achimenes pulchella (L'Hér.) Hitchc. Herb about 35 cm. tall. Leaves opposite, oval, dentate, pubescent, the veins red beneath; flowers axillary, bright red, on long pedicels. Banks of the Danto River, slopes of Mt. Cangrejal, at 300 meters altitude.

BESLERIA L.

Besleria laxiflora Benth. Low shrub 1 meter tall or less. Flowers orange, in stalked, umbellate, axillary clusters. In forests on the lower slopes of Mt. Cangrejal.

Besleria macrocalyx Morton, sp. nov. (*Eubesleria*, *Elongatae*).—Frutex ca. 1.5 m. altus, caulibus obtuse quadrangularibus, ca. 4 mm. diam., vix ramosis, praesertim apicem versus hirsutis, pilis paucicellularibus, usque ad 2.2 mm. longis; petioli 7–16 mm. longi, hirsuti; lamina foliorum oblique elliptica, 9–14 cm. longa, 3.5–5 cm. lata, apice longe acuminata, basi late cuneata, membranacea, remote et argute serrulata, supra viridis, sparse pilosa, subtus pallidior, praecipue in venis hirsuta, venis primariis ca. 7-jugis; inflorescentia axillaris, umbellata, 3–5-flora, pedunculo communi 10–23 mm. longo, parce hirsuto, pedicellis gracilibus, 15–20 mm. longis, parce hirsutis, apice vix incrassatis; calycis lobi fere aequales, fere liberi, lineari-lanceolati, 1.8–2.2 cm. longi, basi ca. 4 mm. lati, anguste acuminati, integri, colorati, externe plus minusve in lineam mediam hirsuti, intus glabri; corolla lutea, in calyce erecta, ecalcarata, ca. 1.7 cm. longa, basi vix gibbosa, tubo externe glabro, sursum ventricosum et ca. 6 mm. lato, in fauce paullo contracto, limbo terminali, patulo, lobis oblongis, ca. 4 mm. longis, rotundatis glabris; ovarium et stylus glabri; discus crassus, annularis, glaber.—Honduras: Slopes of Mt. Cangrejal, Department of Atlántida, Honduras, in forest, altitude 150 meters, June to August, 1938, *T. G. Yuncker, J. M. Koepper & K. A. Wagner* 8399 (type in U. S. National Herbarium, No. 1,746,850; duplicate in Herb. Field Mus.).

Most closely related to *Besleria elongata* Urban, of St. Vincent, which differs in having the calyx lobes narrowly ovate and shorter than the corolla. The leaves, moreover, are larger and merely crenate or crenulate, and have more numerous primary nerves. *Besleria Cyrtanthemum* Hanst., of Mexico, is perhaps related also, but that species has an obsolete common peduncle, very short pedicels, and strongly unequal calyx lobes.

CODONANTHE Hanst.

Codonanthe crassifolia (Focke) Morton. Succulent, epiphytic, glabrous herb. Leaves elliptic, acute, about 4 cm. long; flowers white with pale pink stripes on the outside of the corolla; fruit red, fleshy, ovoid-cordate. Pendent from branches of trees on stream banks, foothills back of La Ceiba.

ACANTHACEAE

BLECHUM Juss.

Blechum pyramidatum (Lam.) Urban. Weedy herb. Inflorescence a spike; flowers pale blue, in the axils of large, ovate-orbicular, veiny bracts about 1 cm. long. Near trail in forest on the lower slopes of Mt. Cangrejal.

HYGROPHILA R. Br.

Hygrophila conferta Nees. Low, decumbent herb, half woody at the base. Flowers white, in axillary clusters. On gravel bars in the Cangrejal River, foothills back of La Ceiba.

JUSTICIA L.

Justicia comata (L.) Lam. Low, decumbent herb. Flowers small, white with pink markings, in rather large, terminal, paniculate clusters. In wet soil, margin of the Cangrejal River, foothills back of La Ceiba.

ODONTONEMA Nees

Odontonema cuspidatum (Nees) Kuntze. A half-woody herb or shrub about 1 meter tall. Leaves oval to oblanceolate, acute to acuminate, up to 25 cm. long; flowers about 2.5 cm. long, the tube slender, bright red, in spike-like, racemose clusters. Near the Cangrejal River, foothills back of La Ceiba; also in thickets on the plains back of Roma, about 25 kilometers east of La Ceiba.

Odontonema paniculiferum Blake. Low shrub about 50 cm. tall. Flowers yellow. On rocky mountain slope above Roma, about 25 kilometers east of La Ceiba, at 300 meters altitude.

RUELLIA L.

Ruellia geminiflora HBK. Herb 30 to 35 cm. tall, slightly woody at the base. Leaves about 3 cm. long, oval-ovate, acute, sparingly pubescent; flowers about 5 cm. long, blue, showy. In

open pine forest in rocky soil on mountain slopes above the village of Las Flores, at 330 meters altitude.

Ruellia tuberosa L. Low herb. Leaves mostly basal, obovate-spatulate, finely appressed-pubescent and with scattered, larger, erect hairs on the upper surface; flowers showy, in pedunculate, cymose clusters; corolla lavender, about 2 cm. long. Abundant in open, grassy areas near Coyoles.

THUNBERGIA Retz.

Thunbergia alata Boj. Low, finely pubescent, herbaceous vine. Leaves hastate, the petioles long, winged; flowers solitary, axillary, showy; corollas buff-orange, some with a dark red throat, others lacking the contrasting color. Scrambling over low plants, edges of thickets along the Cangrejal River, foothills back of La Ceiba.

RUBIACEAE

ALIBERTIA A. Rich.

Alibertia edulis (L. Rich.) A. Rich. Shrub or small tree, about 3 meters tall; bark brown, shredded, glabrous. Leaves large, elliptic to oval-ovate, acute; flowers white, subsessile, in terminal, few-flowered clusters; fruit globose, fleshy. In thickets on the banks of the Danto River, slopes of Mt. Cangrejal, at 150 meters altitude.

APPUNIA Hook. f.

Appunia guatemalensis D. Sm. Glabrous shrub about 1.5 meters tall. Flowers purplish without, white within, sessile in stalked, axillary clusters; fruit small, fleshy, purplish. In thickets on the foothills back of La Ceiba. This is the first report of this genus for Honduras.

BORRERIA Meyer

Borreria laevis (Lam.) Griseb. Low herb, slightly woody at the base. Leaves sessile, about 2 cm. long, narrowly elliptic-lanceolate, glabrous; flowers small, pale pink, sessile, in axillary clusters. In sandy soil along the Aguán River near Coyoles.

CALYCOPHYLLUM DC.

Calycophyllum candidissimum (Vahl) DC. Tree about 9 meters tall and 20 cm. in diameter. Flowers white, numerous, in large, corymbose-paniculate clusters; capsule about 1 cm. long. In open woodland near the village of Medina, at 180 meters altitude.

CEPHAELIS Swartz

Cephaelis tomentosa (Aubl.) Vahl. Half-woody, densely hairy shrub about 1 meter tall. Leaves 15 cm. long or more, ovate, pinnately nerved, with the lateral nerves curving upward; flowers yellow, in stalked, head-like clusters subtended by two large, bright red bracts. In thickets on the lower slopes of Mt. Cangrejal.

COCCOCYPSELUM P. Br.

Coccocypselum herbaceum Lam. Low, trailing, finely pubescent, somewhat succulent herb. Leaves 3 to 4 cm. long, ovate, the nerves beneath and petioles pink; flowers small, in axillary clusters. In open areas in the foothills back of La Ceiba.

DECLIEUXIA HBK.

Declieuxia fruticosa (Willd.) Kuntze, var. **mexicana** (HBK.) Standl. Herb 30 to 60 cm. tall, slightly woody at the base; stem with narrow, wing-like, longitudinal ridges. Leaves linear, sessile, somewhat leathery; flowers small, white, in cymose clusters. In rocky soil in pine forest on the mountain slope above the village of Las Flores, at 330 meters altitude.

GENIPA L.

Genipa Caruto HBK. Tree about 15 meters tall and 40 cm. in diameter. Leaves large, drying dark and shiny above, light and finely pubescent beneath; flowers large, yellow, fragrant, in terminal, cymose clusters; fruit large, round, fleshy, edible. In open forest, semi-arid upland near the village of Medina, at 180 meters altitude.

GEOPHILA Don

Geophila herbacea (L.) Schum. Prostrate herb. Leaves rounded-cordate; flowers small, white, sessile, in stalked, axillary clusters; fruit fleshy, red. Frequent in moist, shady areas, foothills back of La Ceiba.

GUETTARDA L.

Guettarda macrosperma D. Sm. Shrub or small tree about 4.5 meters tall. Leaves appressed-pubescent; flowers in stalked, axillary, cymose clusters, the corolla 4- or 5-parted, white, the tube about 1.5 cm. long, finely appressed-pubescent outside. In thickets, foothills back of La Ceiba.

HAMELIA Jacq.

Hamelia longipes Standl. Small tree about 4.5 meters tall. Leaf nerves and petioles reddish; flowers in open, terminal, racemose cymes, the corolla yellow, the peduncles and pedicels red; berries red to black. In thickets on the banks of the Danto River, slopes of Mt. Cangrejal, at 240 meters altitude; also on the ridge back of Roma, about 25 kilometers east of La Ceiba.

Hamelia nodosa Mart. & Gal. Shrub about 2 meters tall. Leaves large, oval, acute; flowers in large, open, terminal, racemose cymes. In thickets, plains back of La Ceiba.

Hamelia Rovirosae Wernh. Shrub or small tree up to 4.5 meters tall. Leaves opposite or commonly whorled; flowers in terminal, one-sided, cymosely arranged spikes; corollas 2 cm. long or more, red, showy; fruit red. In foothills back of La Ceiba; also on bank of the Salado River, about 20 kilometers west of La Ceiba.

HEMIDIODIA Schum.

Hemidiodia ocimifolia (Willd.) Schum. Herb. Leaves veiny, lanceolate; flowers white, sessile in axillary clusters. In wet soil near the trail on the lower slopes of Mt. Cangrejal, back of La Ceiba.

HOFFMANNIA Swartz

Hoffmannia hondurensis Standl. Shrub about 2 meters tall. Flowers small, cream-colored, in axillary clusters, the pedicels salmon. In deep, moist ravine on slope near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

MORINDA L.

Morinda panamensis Seem. Small tree about 3.5 meters tall. Flowers small, white, clustered in stalked heads; fruit fleshy. In the foothills back of La Ceiba.

PALICOUREA Aubl.

Palicourea crocea (Swartz) R. & S. Shrub or small tree about 4.5 meters tall. Flowers in paniculate, terminal clusters; corolla orange-yellow; pedicels and peduncles dark orange to red; fruit black. In forests on the lower slopes of Mt. Cangrejal.

PENTAGONIA Benth.

Pentagonia Donnell-Smithii Standl. Tree about 7 meters tall and 20 cm. in diameter, the wood soft. Leaves very large, up

to 90 cm. long and 50 cm. wide, obovate, acute; flowers in axillary, paniculate clusters; fruit globose, somewhat fleshy. In forests on the mountain range back of Roma, about 25 kilometers east of La Ceiba, at 300 meters altitude.

PSYCHOTRIA L.

Psychotria brachiata Swartz. Shrub or small tree about 4.5 meters tall. Flowers small, sessile, yellow, in terminal, paniculate clusters; fruit blue. In forest, foothills back of La Ceiba.

Psychotria carthaginensis Jacq. Shrub about 3 meters tall, glabrous. Leaves more or less shiny, elliptic-obovate, acute, short-petioled; flowers small, white, on whitish pedicels in terminal, paniculate clusters. In ravine in semi-arid woodland region near Coyoles.

Psychotria chiapensis Standl. Tree about 7 meters tall. Leaves elliptic to obovate, up to 20 cm. long or more; flowers white, in terminal, paniculate clusters; fruit up to 15 mm. long, globose, green. In forest on the banks of the Danto River, slopes of Mt. Cangrejal.

Psychotria crebrinervia Standl. Shrub or small tree about 4.5 meters tall, the small branches commonly hollow. Leaves 20 cm. long or more, acuminate; flowers small, cream-colored, numerous, in large, terminal, paniculate clusters. In thickets on the foothills back of La Ceiba; also in open forest on the ridge back of Roma, about 25 kilometers east of La Ceiba, at 270 meters altitude.

Psychotria cuspidata Bredem. Shrub or small tree about 4.5 meters tall. Leaves elliptic-lanceolate, acuminate, cuspidate, glabrous. Flowers white, in terminal, paniculate clusters; fruit becoming black. In forests on the slope back of Roma, about 25 kilometers east of La Ceiba, at 300 meters altitude.

Psychotria graciliflora Benth. Shrub about 1 meter tall. Leaves elliptic-oblongate, acuminate; flowers cream-colored, in paniculate clusters terminal on side branches; fruit red. On river banks, foothills back of La Ceiba.

Psychotria grandis Swartz. Tree about 6 meters tall. Leaves large, up to 30 cm. long, elliptic-obovate, acute; flowers white, in long-stalked, large, paniculate clusters; fruit reddish. In thickets on the plains near Roma, about 25 kilometers east of La Ceiba.

Psychotria involucrata Swartz. Shrub or small tree about 3.5 meters tall. Leaves glabrous, elliptic, acuminate; flowers small,

white, in small, compact, head-like clusters with numerous rather large, reddish bracts. On low ground near the Salado River, about 20 kilometers west of La Ceiba.

Psychotria limonensis Krause. Shrub about 2 meters tall. Leaves large, elliptic, acute; flowers numerous, small, white, in short-stalked, terminal, paniculate clusters. In thickets, lower slopes of Mt. Cangrejal.

Psychotria marginata Swartz. Shrub or small tree about 3 meters tall. Leaves elliptic-oblongate, acuminate, glabrous; flowers greenish, in loose, terminal, paniculate clusters; fruit ribbed, globose, red. In forests on the slopes of Mt. Cangrejal.

Psychotria microdon (DC.) Urban. Shrub or small tree about 3 meters tall. Leaves comparatively small, mostly 4 to 6 cm. long, glabrous; flowers greenish white, in very small, paniculate clusters, terminal on lateral branches. In open forest near the village of Las Flores.

Psychotria Oerstediana Standl. Low shrub about 1 meter tall. Leaves elliptic- or oval-obovate, acute to acuminate; flowers white, in subsessile, paniculate clusters, terminal on the branches. Frequent in thickets along the Cangrejal River, foothills back of La Ceiba; also in semi-arid woodland region near Coyoles.

Psychotria patens Swartz. Shrub or small tree about 3 meters tall. Leaves elliptic-lanceolate, attenuate-acuminate, glabrous; flowers white, in elongate, terminal, paniculate clusters, the pedicels and peduncles purplish; fruit wine-colored to bluish. In thickets on the lower slopes of Mt. Cangrejal.

Psychotria pubescens Swartz. Shrub or small tree up to 6 meters tall. Leaves elliptic, acuminate, finely pubescent beneath, particularly along the midrib, the veins often reddish; flowers greenish yellow, small, in terminal, stalked, paniculate clusters; fruit purple. In thickets, foothills back of La Ceiba; also in thickets in semi-arid upland region near the village of Las Flores, at 240 meters altitude.

Psychotria sessilifolia Mart. & Gal. Shrub about 1 meter high or less; leaves elliptic, minutely pubescent beneath, at least along the nerves; flowers small, in sessile, terminal, paniculate clusters. In thickets in semi-arid upland region near the village of Medina, at 200 meters altitude.

Psychotria suerrensii D. Sm. Small tree about 4.5 meters tall. Leaves elliptic-lanceolate, 12 to 18 cm. long, long-acuminate,

nearly glabrous; flowers white, in compact, axillary clusters. In deep forest along the Danto River, slopes of Mt. Cangrejal, at 300 meters altitude.

Psychotria undata Jacq. Shrub about 2.5 meters tall, the young growth hairy. Leaves elliptic-obovate, acuminate, hairy on both surfaces; flowers small, in sessile, terminal, paniculate clusters; fruit hairy. Bank of stream on slope above the village of Las Flores, at 300 meters altitude.

RICHARDIA L.

Richardia scabra L. A low, hairy, weedy herb. Flowers white, in terminal, head-like, bracteate clusters. In sand near the seashore, vicinity of La Ceiba.

RONDELETIA L.

Rondeletia stachyoidea D. Sm. Small tree about 4.5 meters tall. Leaves elliptic-lanceolate, more or less drooping, long-tapering at both ends, silky-hairy beneath; flowers in elongate, paniculate, spike-like clusters. In forests on the foothills back of La Ceiba.

SOMMERA Schlecht.

Sommerra grandis (Bartl.) Standl. Tree about 9 meters tall and 15 cm. in diameter. Leaves elliptic-obovate, abruptly pointed, glabrous above, hairy beneath; flowers white, in few-flowered, stalked, axillary clusters; fruit hairy. In forests on the lower slopes of Mt. Cangrejal, at 180 meters altitude.

CUCURBITACEAE

LUFFA Adans.

Luffa cylindrica (L.) Roem. Herbaceous vine. Leaves large, palmately lobed, scabrous; flowers yellow. Climbing in thickets on the plains near La Ceiba.

MOMORDICA L.

Momordica Charantia L. Slender, herbaceous vine. Leaves thin, deeply palmate-lobed, the lobes toothed; flowers yellow; fruit fusiform, rough, yellow, its seeds imbedded in a red, pulpy interior which is exposed at maturity by the splitting of the fruit. Climbing in thickets near the Aguán River, vicinity of Coyoles, and elsewhere. Common.

SICYDIUM Schlecht.

Sicydium tamnifolium (HBK.) Cogn. Herbaceous vine. Leaves ovate-cordate, acute, pubescent or scabrous; flowers small,

greenish, in open, paniculate clusters; fruit dark blue. On lower slopes of Mt. Cangrejal, back of La Ceiba; also in open, semi-arid, cut-over area near the village of Medina.

LOBELIACEAE

ISOTOMA Lindl.

Isotoma longiflora (L.) Presl. Herb 30 cm. tall or less, pubescent. Leaves oblanceolate, toothed, the teeth with spinose tips; flowers white, long-tubular, axillary. Said to be poisonous. Abundant locally on the plains near Roma, about 25 kilometers east of La Ceiba.

LOBELIA L.

Lobelia splendens Willd. Herb about 60 cm. tall. Flowers cardinal red. Occasional on sandbars in the Aguán River near Coyoles.

COMPOSITAE

AGERATUM L.

Ageratum conyzoides L. A weedy, pubescent herb up to 60 cm. tall. Flowers light blue. Abundant in moist areas on the plains and in thickets about La Ceiba.

BIDENS L.

Bidens pilosa L. var. *radiata* Sch. Bip. Tall, weedy herb. Ray flowers white, the disk yellow. A common plant throughout the region about La Ceiba.

CHAPTALIA Vent.

Chaptalia nutans (L.) Polak. Low, stemless herb. Leaves oblong-obovate, densely tomentose beneath, basal, forming a rosette; flower heads on scapes up to 60 cm. tall, the rays dark red. Frequent in open areas about La Ceiba.

CLIBADIUM Allem.

Clibadium polygynum Blake. Herb, or more or less woody, 1.5 meters tall. Leaves ovate-lanceolate, opposite, acuminate; heads whitish, numerous, in paniculately cymose clusters. On the banks of the Danto River, slopes of Mt. Cangrejal, at 240 meters altitude.

ECLIPTA L.

Eclipta alba (L.) Hassk. Low, weedy herb with rough pubescence. Leaves linear-lanceolate, opposite; heads small, the rays

very small, whitish. In marshy areas along the seashore near La Ceiba.

ERECHTITES Raf.

Erechtites hieraciifolia (L.) Raf. Herb about 60 cm. tall. Leaves lanceolate, pinnately lobed or deeply sharp-toothed; heads greenish yellow; pappus of profuse, white hairs. In waste areas near La Ceiba.

ERIGERON L.

Erigeron bonariensis L. Herb about 1 meter tall. Leaves linear-oblong; heads greenish white; pappus of tan-colored bristles. On banks of the Danto River, lower slopes of Mt. Cangrejal.

Erigeron canadensis L. Herb about 1 meter tall. Heads whitish. A widely distributed, weedy plant, common in waste places about La Ceiba.

EUPATORIUM L.

Eupatorium albicaule Sch. Bip. Shrub or small tree up to 7 meters tall and 20 cm. in diameter, sometimes more or less scandent. Leaves elliptic-lanceolate, toothed, 3-nerved from near the base; flowers white; pappus whitish. In thickets on the lower slopes of Mt. Cangrejal; also in semi-arid woodland region near Coyoles.

Eupatorium amygdalinum Lam. Glabrous herb about 1 meter tall. Leaves elliptic-oblong, entire, somewhat leathery, the midvein prominent; flowers pale lavender; heads arranged in large, corymbose clusters. In open forest in semi-arid upland region near the village of Las Flores, at 300 meters altitude.

Eupatorium Carletonii Robinson. Low, decumbent, glabrous herb. Leaves pinnately dissected, the divisions narrowly linear and more or less divided towards the outer ends. Flowers rose or lavender; involucre bracts linear-oblong; pappus bristles tan-colored; heads small, in loose, paniculate clusters. On rocky cliffs near the Danto River, slopes of Mt. Cangrejal, at 300 meters altitude.

Eupatorium macrophyllum L. Herb about 1 meter tall, finely pubescent, somewhat woody toward the base. Leaves ovate, pubescent; flowers white; pappus bristles white. At edges of thickets in foothills back of La Ceiba.

LYCOSERIS Cass.

Lycoseris crocata (Bertol.) Blake. Woody vine. Leaves elliptic-lanceolate, densely tomentose beneath, finely but sparingly

toothed. Heads large, solitary, terminal on the branches. In thickets along a stream near the village of Las Flores, at 240 meters altitude.

MELANTHERA Rohr

Melanthera nivea (L.) Small. Herb, more or less woody at the base, about 1 meter tall. Leaves ovate, acuminate, scabrous. Heads small, long-stalked, commonly solitary; disk scaly, the scales very sharp-pointed; flowers white. Sandy beach near the village of Salado, about 20 kilometers west of La Ceiba; also on bank of stream in the foothills back of La Ceiba.

NEUROLAENA R. Br.

Neurolaena lobata (L.) R. Br. Herb about 1 meter tall. Leaves scabrous, coarsely serrate or the larger leaves three-lobed, the midrib prominent; heads yellow, in corymbose clusters. In thickets on slope near Puente Alto, about 50 kilometers east of La Ceiba, at 240 meters altitude.

PLUCHEA Cass.

Pluchea purpurascens (Swartz) DC. Densely pubescent herb about 1 meter tall. Leaves ovate-oblong, acutish, the midrib prominent; heads pink, in corymbose clusters. In marsh near the seashore, vicinity of La Ceiba.

POLYMNIA L.

Polymnia maculata Cav. Weedy herb about 2 meters tall. Leaves large, more or less scabrous, opposite, coarsely toothed, the upper ones ovate-lanceolate, the lower broadly orbicular-ovate; heads rather large, in few-headed clusters; rays conspicuous, yellow. Growing in great abundance in a coconut grove near La Ceiba.

POROPHYLLUM Adans.

Porophyllum punctatum (Mill.) Blake. Erect herb about 1.5 meters tall, the stems red. Leaves about 2 cm. long, elliptic-oblong, acute; heads narrow, solitary, on slender stalks at the ends of branches; corollas yellowish; pappus tawny. In sandy soil, thickets along the Aguán River near Coyoles.

SCHISTOCARPHA Less.

Schistocarpa oppositifolia (Klatt) Rydb. Erect herb about 1 meter tall. Leaves large, ovate, shallowly toothed; heads in paniculately corymbose clusters; flowers yellowish; pappus hairs

tawny; involucre bracts thin and papery. In thickets on slope near Puente Alto, east of La Ceiba, at 850 feet altitude.

SENECIO L.

Senecio kermesinus Hemsl. Large, glabrous, woody vine. Leaves alternate, with few very small teeth, elliptic-oblong, acute to acuminate; heads handsome, long-stalked, in few-headed umbellate clusters; flowers deep orange, fragrant; pappus white. In thickets about La Ceiba.

TITHONIA Desf.

Tithonia Pittieri (Greenm.) Blake. Shrub or small tree about 4.5 meters tall, the stems hairy. Leaves linear-lanceolate, long-acuminate, densely pubescent beneath, rough-scabrous above; heads rather large, mostly solitary at the ends of the branches; rays yellow. On margin of old irrigation ditch near Coyoles.

TRIDAX L.

Tridax procumbens L. Low, decumbent, hairy herb. Leaves small, toothed, scabrous; heads on long peduncles; rays white; pappus bristles plumose. On gravel bars in the Aguán River near Coyoles.

VERBESINA L.

Verbesina sublobata Benth. Shrub or small tree about 3 meters tall, the young stems densely tomentose. Leaves alternate, deeply pinnate-lobed, decurrent on the petiole, moderately pubescent above with short, erect, semi-rigid hairs, brown-tomentose beneath. In thickets on slope near Puente Alto, east of La Ceiba, at 250 meters altitude.

VERNONIA Schreb.

Vernonia scorpioides (Lam.) Pers. Herb 1.5 meters tall or less, sometimes somewhat woody at the base, densely pubescent with soft, brown hairs. Leaves alternate, ovate, acuminate, densely pubescent. Heads small, pink or lavender, showy, sessile on branching, one-sided, scorpioid spikes; pappus bristles white. Very abundant in open, sunny places about La Ceiba.

WEDELIA Jacq.

Wedelia trilobata (L.) Hitchc. A creeping herb. Leaves opposite, sessile, chiefly 3-lobed above the middle, narrowing toward the base; heads large, mostly solitary, long-pedunculate; rays yellow. In sand near the seashore, vicinity of La Ceiba.

STUDIES OF
THE VEGETATION OF MISSOURI—I
NATURAL PLANT ASSOCIATIONS AND
SUCCESSION IN THE OZARKS OF MISSOURI

BY

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CONTENTS

	PAGE
LIST OF ILLUSTRATIONS	351
INTRODUCTION.	353
NATURAL PLANT ASSOCIATIONS AND SUCCESSION IN THE OZARKS OF MISSOURI.	353
I. Sugar maple-bitternut hickory association	358
II. Sugar maple-white oak association	372
III. Oak-hickory association	387
IV. Oak-pine association	393
V. White oak-red maple association	397
SUBCLIMAX STAGES IN THE OZARKS.	401
PLANT INDICATORS OF ACIDITY AND ALKALINITY	404
ECOLOGICAL VARIATIONS INDUCED BY BURNING, LOGGING, CLEARING, AND OTHER UNNATURAL CAUSES.	408
EXAMPLES TAKEN FROM SPECIFIC AREAS SHOWING PARTICULAR STAGES WITHIN AN ASSOCIATION	421

LIST OF ILLUSTRATIONS

TEXT FIGURES

PAGE

9. *Salix longipes*-*Hamamelis vernalis* associates on gravel bar at mouth of Indian Creek and White River, near Baxter, Stone County 359
10. *Salix longipes* associates on gravel bar, four miles northeast of Waynesville, Pulaski County 360
11. *Dianthera americana* forming dominant herbaceous growth along gravel bar on Bourbeuse Creek at Glaser Ford, three and one-half miles southwest of Bem, Gasconade County 361
12. *Salix nigra*, instead of *Salix longipes* var. *Wardii*, pioneering on gravel. Along Moreau River two miles southeast of Jefferson City, Cole County 362
13. Deposit of muddy alluvium above sand on bar on Little North Fork of White River, one and one-half miles south of Theodosia, Ozark County . 363
14. *Acer saccharinum*-*Populus deltoides* associates on right side behind gravel bar, between Reed Springs and Viola, Stone County 364
15. *Ulmus americana*-*Fraxinus pensylvanica* var. *lanceolata* associates on alluvium of valley along Jacks Fork of Current River, north of Monteer, Shannon County 365
16. Along Huzzah Creek, two miles southeast of Davisville, Crawford County. 371
17. Limestone glade along Niangua River, two miles south of Corkery, Dallas County 372
18. Limestone glade with dominants of *Silphium laciniatum*, *Psoralea tenuiflora*, and *Bouteloua curtipendula* on bluffs along Osage River, two miles northwest of Wisdom, Benton County 373
19. Red cedar glade or bald on dolomitic limestone, near Taney County line, in Stone County 374
20. Bald knob west of Table Rock, west of Branson, Taney County 375
21. *Diospyros virginiana* initiating woody growth on limestone glade along Niangua River, two miles south of Corkery, Dallas County 376
22. *Quercus Muhlenbergii* invading an associates with *Diospyros virginiana* and *Bumelia lanuginosa* along the bluffs of Osage River (Lake-of-the-Ozarks), at Riverview, Morgan County 377
23. *Quercus Muhlenbergii*-*Fraxinus americana* associates dominating grassy slopes along headwaters of Bryant Creek, two miles southeast of Cedar Gap, Wright County 378
24. Bald knob, east of McClurg, Ozark County 379
25. Similar to Fig. 24, three miles northwest of Vichy, Maries County, except that forest of *Acer saccharum*-*Quercus alba* associates has more nearly closed the originally open glade 380
26. *Acer saccharum*-*Quercus alba* climax associates well developed over a limestone substratum, Taney County 381
27. Bluffs along White River just west of Shreiner's Ferry, Barry County . 382
28. Bee Bluff, along Current River, northeast of Eminence, Shannon County . 383
29. Bee Bluff, along Current River, northeast of Eminence, Shannon County . 385
30. Limestone bluffs along Eleven Points River, near mouth of White Creek, Oregon County 386
31. A typical Ozark landscape, south of Harley, Barry County 388
32. Porphyritic trachyte glade of Red Rock Mountain, near Irondale, Washington County 389

	PAGE
33. <i>Rhus Copallina</i> invading prairie habitat, one mile from Riverview bluffs, Morgan County	390
34. Upland woods with dense, grassy cover near head of Mud Creek, twelve miles north of Poplar Bluff, Butler County	391
35. An oak-hickory associes on a flat upland near Dillard, Crawford County .	392
36. <i>Pinus echinata</i> developed in almost pure stand on Pine Bluff, overlying Roubidoux sandstone along Meramec River, four miles south of St. Clair, Franklin County	394
37. Pure pine stand on ridge top north of Bunker, Reynolds County . . .	395
38. South-facing limestone bluffs along White River opposite Table Rock, Taney County	399
39. Right half of picture in background in white is covered by <i>Juniperus virginiana</i> overlying a limestone substratum; left half of picture mixed oak and pine overlying chert substratum. Along highway No. 19, two miles north of Eminence, Shannon County	400
40. Right half of picture in background in white is covered by <i>Juniperus virginiana</i> overlying a limestone substratum; left half of picture mixed oak and pine overlying chert substratum. Along highway No. 19, two miles north of Eminence, Shannon County	402
41. Effect of a spring burn, showing a very light density of forest floor coverage. Note the open patches of soil between the herbs. Twelve miles north of Poplar Bluff, Butler County	409
42. Damage done by summer burn, along highway No. 49, just south of Black, Reynolds County	410
43. Damage done by summer burn, along highway No. 49, just south of Black, Reynolds County	411
44. Flat ridge top in <i>Quercus alba-Quercus stellata</i> woodland, four miles northwest of Bunker, Reynolds County	413
45. <i>Quercus alba-Quercus velutina-Quercus stellata</i> woodland on flat ridge top, four miles northwest of Bunker, Reynolds County	414

STUDIES OF THE VEGETATION OF MISSOURI—I

JULIAN A. STEYERMARK

INTRODUCTION

The present paper is the result of observations and records made by the author while collecting and making a systematic study of the flora of Missouri during the past fifteen years. He does not profess to be a trained ecologist in the modern usage of that term. As a taxonomist who, in making a systematic study of the flora, has collected in every county of the state in order to make the thorough phytogeographical survey that was necessary to the understanding of the distribution and limitations of species and varieties, he has observed, collected, and recorded the flora found in every conceivable type of association (in the usual sense employed for this expression) in the state. Specimens of all the plants mentioned in the present paper may be found in the Herbarium of the Missouri Botanical Garden and in the Herbarium of Field Museum. Such specimens form a concrete and definite basis for the observations made in this paper. Moreover, they serve as the only tangible evidence whereby the statements made by the author may be verified or refuted.

The terms "association," "consociation," "associes," "society," "climax," and "dominant" used in the present paper are to be applied in the ordinary and usual sense in which they are employed generally by ecologists in the United States, and agree with the concept of these terms as originally given by Warming,¹ Weaver and Clements,² and many others. The 164 examples given at the end of the paper represent actual areas of ground surveyed in detail by the author in making observations within the Ozarks. They may be considered as large-scale, natural plots selected because they represent typical cross sections which occur in diverse areas within the Ozark region.

NATURAL PLANT ASSOCIATIONS AND SUCCESSION IN THE OZARKS OF MISSOURI

Some of the stages of succession noted here will be found in parts of the state other than the Ozarks, for example, in the glaciated

¹ E. Warming, *Oecology of plants*. 422 pp. Clarendon Press, Oxford, England. 1909.

² J. E. Weaver and F. E. Clements, *Plant ecology*. 520 pp. McGraw-Hill Book Company, New York. 1929.

prairie region north of the Missouri River and outside the Ozarks, or in the southeastern lowland area, or in the unglaciated prairie region of west-central and southwestern Missouri.

Attention should be called to the fact that the past and intricate geological history of the Ozark region has been one of the chief factors in causing the migration and present distributional status of many of the species. For example, the present distribution of the bald cypress and other southeastern lowland species in Missouri is delimited by the incursion of the Mississippi embayment in past geological periods. Again, the present northern and northwestern limits of the southern yellow pine and species with similar distribution in the Ozarks of Missouri do not result primarily from any factors of the soil or climate of the present, since similar conditions are encountered in northern Missouri, but rather from factors of past geological history, such as the extermination by glaciers of the Ozark flora north of the Ozark region, or a climatic disturbance causing a block or change in migration, or elimination of habitats previously suitable to the species but now exterminated north of the Ozark region.

The Ozark flora is an extremely varied one, and its composition has been made much more intricate and complex by the uplifts and peneplanations of the land, varied rock formations, and long history as a land area since the end of the Paleozoic era. This accounts for the great number and variety of stages of development within a given plant association.

Reference is here made to *Plant ecology* by Weaver and Clements. It will be found that a number of conclusions reached in this report differ in some ways from those made in that publication. The reasons for this are several. In the first place, no critical study of the natural plant successions in the Ozark flora has previously been attempted. Thus, while some general statements in Weaver and Clements' book hold true, a number of large generalizations made in that work to cover the region in which the Ozarks are located, concerning climax formations and associations, do not hold. Further than this, these authors, by stressing the physical factors of the soil, have not sufficiently considered variations in the chemical nature of the soil or the past geological history of the region as factors which might cause different stages in development of an association or account for the appearance of certain consocieties and dominants. Thus, for example, the maple-beech forest is regarded by them as a typical association of the deciduous forest climax formation; but, in Missouri, this

formation is found only in the southeastern portion, and mainly on Crowleys Ridge, the beech being limited to this part of the state on account of the past geological history and the meanderings of the Mississippi River and the relation of this to the Crowleys Ridge area. The beech could, on the basis of soil and climatic conditions and its shade tolerance, grow farther west where the maple is found, but past geological history has restricted it to its present area. In the Ozarks the sugar maple (*Acer saccharum*) forms a climax with some of the oaks (*Quercus alba* and *Q. borealis* var. *maxima*) along rich, wooded slopes and bluffs, rather than with beech. Furthermore, the sugar maple climax is not reached unless the soil ranges from neutral to alkaline, for where acid soils exist, other climax species, such as *Quercus coccinea* and *Pinus echinata*, are found. In the Ozarks the acidity of the soils plays an important part in causing different stages and units of succession, and many of the associates owe their appearance in the development of the vegetation to the particular stage of substratum decomposition or formation. Thus, in the Ozarks, the basis for the appearance and difference in the oak-hickory or pine-oak association on the one hand and the sugar maple association on the other, lies in the acidity and chemical nature of the soil, rather than, as Weaver and Clements maintain, in the physical or moisture condition of the soil. The limiting factor, in other words, appears to be the presence or absence of limestone, rather than soil moisture and shade. This will be discussed further in this paper.

In Missouri different types of soils within a limited region appear to result in entirely different associations and climaxes. For so limited an area this conclusion is at variance with the single climax type admitted for the region included within the Ozarks by Weaver and Clements. However, some of the Old World ecologists appear to confirm the conclusions reached by the present author. Du Rietz,¹ for example, points out that "contrary to the monocl意思ax theory developed by Clements and Braun-Blanquet, I find it necessary, however, to maintain the polyclimax theory developed by Domin, Gams, Gleason, Nichols, Nordhagen, Scharfetter, Tansley, myself, etc., i.e., to admit that several climax-phytocoenoses—in many cases with very little relationship to each other—may occur side by side in the same vegetation region, but in edaphically different habitats. . . . My own field experience certainly does not support the theory of the power of a uniform climate to transform all these edaphically different habitats into one comparatively uniform 'climax-habitat' ('climax-

¹ G. Einar du Rietz, Classification and nomenclature of vegetation. Svensk. Bot. Tidskr. 24, H. 4, p. 497. 1930.

soil,' etc.), as postulated by the monoclimate theory." The author continues his discussion by showing that in various places in Europe many climaxes are developed in the same region. He states¹ that "in the *Quercus* region of south Sweden, for instance, certainly both *Quercus* forests and *Picea-Pinus* forests, among others, must be admitted as climax-phytocoenoses, the former on better and the latter on poorer soils. In the case of the alpine vegetation regions of the Alps and of Scandinavia, there is a complete agreement among Scandinavian ecologists that the dominating dwarf-shrub-heath and grass-heath of the acid and moderately snow-covered ground in the low-alpine and middle-alpine belts respectively, are by no means the only climax-phytocoenoses of these regions as assumed by Braun-Blanquet. Parallel with them there also occur not only subneutrophilous (pH 5.5-7) and neutrophobous climax phytocoenoses both chionophobous (on wind-exposed ridges) and chionophilous (on snow-loving, i.e. 'Schnee-boden' communities), consisting of grass, herb, dwarf-*Salix*, moss, and lichen communities very different from the dominant subchionophobous heath."

Tansley² states that "the so-called 'polyclimax theory' takes what appear to be permanent types of vegetation under given conditions and calls them climatic conditions of the region and on the most favorable soils the climatic climax is reached by the succession; but that on less favorable soils of special character different kinds of stable vegetation are developed and remain in possession of the ground, to all appearances as permanently as the climatic climax. These are called *edaphic* climaxes, because the differentiating factor is a special soil type." Other climaxes are described, caused by physiography, grazing, fire, and mowing. Of these he says,³ "In each case the vegetation appears to be in equilibrium with all the effective factors present, including of course the climatic factors, and the climax is named from the special factor differentiating the vegetation from the climatic climax. . . . The word climax is used in its simple and natural signification of a culmination of development—a permanent or apparently permanent condition reached when the vegetation is in equilibrium with all the incident factors." Speaking of the relation of soil on succession, Tansley states³ that while it is simple to believe that "the soil profile runs *pari passu* with the development of the vegetation it bears, and that consequently the

¹ Ibid., p. 499.

² A. G. Tansley, Vegetational concepts and terms. Ecology 16: 292. 1935.

³ Ibid.

mature climatic soil type corresponds and co-exists with the climatic climax community," yet he goes on to state that this is not true, because "even when profile development under the influence of climate is perfectly normal and regular, the climatic climax community may establish itself long before the soil is mature, and may not be substantially altered by the later stages of profile maturation. Again a climatic climax may establish itself on a soil which is kept immature by geological and geographical causes, as on a steep slope. *And finally it is now generally agreed by pedologists that some rocks, owing to the simplicity of their composition, produce soils which can never form the normal climatic mature profile, and these may or may not bear the typical climatic climax vegetation.*" (The italics are the present author's.)

The field experience of the author in his observations on the Missouri flora is in full agreement with the statements quoted above by du Rietz and Tansley. The Ozarks offer a wonderful example in soil diversities and give ample opportunities of corroborating the opinions of these ecologists concerning the influence of soils on the various types of vegetation within a small region. Thus, we find that on the acidic substrata of chert, sandstone, or granitic rock an associates culminating in oak, hickory, southern yellow pine, *Acer rubrum*, *Nyssa sylvatica* var. *caroliniana*, and *Cornus florida* is as characteristic a climax association as is that of *Acer saccharum*, *Quercus Muhlenbergii*, and other species developing on a limestone soil. The fact that several climaxes may exist in the Ozarks is proven by these permanent, well-marked associations which have originated from different substrata, yet may exist, as they often do, contiguous to each other. The fact remains that they are not climatic climaxes, as argued by Weaver and Clements, because the climate has not differentiated these diverse, stable associations, one on limestone, the other on chert, sandstone, or porphyritic trachyte or granite. Rather, these climaxes are edaphic and owe their diversity to their separate selections of soil conditions.

Friesner and Potzger¹ concluded, after a study of certain areas in Indiana in which soil reactions between the *Fagus-Acer* and *Quercus-Carya* communities were compared, that "the range of reaction in surface soils for beech-maple does not show much difference from that of oak-hickory, except that the reaction spread is a little nearer alkalinity in beech-maple, extending from pH 4.5 to 7.53, and a little

¹ Ray C. Friesner and J. E. Potzger, Contrasts in certain physical factors in *Fagus-Acer* and *Quercus-Carya* communities in Brown and Bartholomew counties, Indiana. Butler Univ. Bot. Stud. 4: 8-9. 1937.

more acid in oak-hickory, extending from pH 4.1 to 7.24. . . . The majority of the soil samples gave a decidedly more acid reaction for oak-hickory than was found in any of the beech-maple areas except one. It will also be seen that while the oak-hickory range exhibits as wide a spread as the beech-maple, the majority of the samples fall within a much narrower range which is more acid than the majority of the readings for the beech-maple soils." As will be shown in the following portion of this paper on plant associations in the Ozarks, the oak-hickory association develops upon an acid substratum, while *Acer saccharum* develops from a limestone substratum and *Acer rubrum* from an acidic cherty, sandstone, or granitic or porphyritic trachyte substratum.

In Weaver and Clements' *Plant ecology*, three associations, i.e., the oak-hickory association, maple-beech association, and oak-chestnut association comprise the three associations in the deciduous forest climax formation, while in this report five associations are described.

The climax formation in the Ozarks is a mesophytic forest. The climate is of the type which effects such a mesophytic development. This mesophytic climax forest is made up of various associations.

Units for discussion in the Ozarks have arisen from the following sources: (1) stages in flood-plain formation; (2) ridge tops and plateau areas; (3) ravines and upper drainage heads of the tributaries in acid soil areas; and (4) stages in cover over an eroded limestone bluff or open glade. Some of these associations, therefore, depend on the type of rock substratum from which they start. Thus, the development or succession of the vegetation is closely correlated with the type of rock in the particular area under discussion.

The five associations included within this climax formation are: (I) sugar maple-bitternut hickory association; (II) sugar maple-white oak association; (III) oak-hickory association; (IV) oak-pine association; and (V) red maple-white oak association.

I. SUGAR MAPLE-BITTERNUT HICKORY ASSOCIATION

(*Acer saccharum*-*Carya cordiformis*)

(1) The first association, the sugar maple-bitternut hickory (*Acer saccharum*-*Carya cordiformis*) association, is the climax stage reached from a development of the flood-plain flora. The developmental stages or associates of this association are definitely correlated with the development and maturity of the stream. Most of the smaller Ozark streams are still in some stages of youth and conse-

quently are dashing and swift-flowing types, carrying loads of chert which have been eroded and borne from the hills. At the stage when the stream is still small and youthful, with a rocky bed loaded with gravel deposits, occurs the first developmental stage, the Ward willow–witch hazel (*Salix longipes* var. *Wardii*–*Hamamelis vernalis*) associes. This shrubby willow pioneers with the witch hazel along all the smaller, rock-laden streams or along the gravel bars or rocky deposits of streams which are in a more mature stage of development (fig. 9). In the northern and western border of the Missouri Ozarks, in much of the area of the Niangua, Osage, lower Gasconade,



FIG. 9. *Salix longipes*–*Hamamelis vernalis* associes on gravel bar at mouth of Indian Creek and White River, near Baxter, Stone County.

and Pomme de Terre rivers, the witch hazel is absent, leaving Ward's willow as the sole dominant of the first stage of the flood-plain association (fig. 10). Witch hazel is found all over the eastern and southern Ozarks.

Sycamore (*Platanus occidentalis*) is always a conspicuous member (consociates) of the willow–witch hazel associes. It is particularly dominant on gravelly and sandy deposits. Along the gravel bars and sandy deposits of the larger Ozark streams such as the Current River, Piney River, Gasconade River, Black River, White River, and others, it and Ward's willow are the pioneers, while alder and usually witch hazel are absent. Alder (*Alnus rugosa*) is often associated with the willow, witch hazel, and sycamore, but is commonest along the smaller tributaries and headwaters. These four species (Ward's willow, witch hazel, sycamore, and alder) make up the dominants or consociates. Sometimes the sand grape (*Vitis rupe-*

tris), ninebark (*Physocarpus opulifolius* var. *intermedius*), and *Cornus obliqua* are associated with these. Water willow (*Dianthera americana*) is a conspicuous herbaceous dominant in the willow-witch hazel associates and is found in dense colonies, rooting along the gravelly, shallower margins of most of the streams, especially the smaller ones (fig. 11). Chairmakers' rush (*Scirpus americanus*) is often associated with water willow on gravelly areas.



FIG. 10. *Salix longipes* associates on gravel bar, four miles northeast of Waynesville, Pulaski County.

Many of the extensive gravel bars may be covered with:

<i>Ambrosia elatior</i> var. <i>artemisiaefolia</i>	<i>Hemicarpha micrantha</i>
<i>Ambrosia trifida</i>	<i>Ipomoea hederacea</i>
<i>Amsonia illustris</i>	<i>Lespedeza capitata</i>
<i>Commelina erecta</i>	<i>Lespedeza virginica</i>
<i>Cyperus esculentus</i>	<i>Leucospora multifida</i>
<i>Cyperus inflexus</i>	<i>Lindernia dubia</i> var. <i>major</i>
<i>Desmodium sessilifolium</i>	<i>Mollugo verticillata</i>
<i>Digitaria sanguinalis</i> (common)	<i>Oxalis stricta</i>
<i>Diodia teres</i>	<i>Panicum virgatum</i> (common)
<i>Eragrostis hypnoides</i>	<i>Polygonum lapathifolium</i>
<i>Eragrostis pilosa</i>	<i>Polygonum pensylvanicum</i>
<i>Euphorbia corollata</i>	<i>Rorippa islandica</i> var. <i>microcarpa</i>
<i>Euphorbia maculata</i>	<i>Xanthium pensylvanicum</i>
<i>Euphorbia supina</i>	

The above gravel bar species may be expected to occur on most gravel bars along the streams, the amount of sand on the one extreme and muddy alluvium on the other changing materially the aspect of the composition of the flora.

(2) Farther away from the margin of the rocky stream a richer soil is gradually built up by successive alluvial deposits (fig. 13).

A new associates of silver maple-cottonwood (*Acer saccharinum*-*Populus deltoides*) develops here. Other dominants (consociates) usually found with silver maple and cottonwood are river birch (*Betula nigra*), black willow (*Salix nigra*), and buttonbush (*Cephalanthus occidentalis*) (fig. 14). As the silver maple-cottonwood associates gradually gains possession of the better soil, witch hazel disappears, but sycamore and Ward's willow of the preceding associates persist into this new succession. Instead of cottonwood with silver maple, as in the southeastern Missouri Ozarks, one finds green ash (*Fraxinus pensylvanica* var. *lanceolata*) in the western Ozarks along



FIG. 11. *Dianthera americana* forming dominant herbaceous growth along gravel bar on Bourbeuse Creek at Glaser Ford, three and one-half miles southwest of Bem, Gasconade County. Note *Salix longipes* var. *Wardii* immediately behind *Dianthera* colony.

the Gasconade River, where cottonwood is quite rare. In the southeastern Ozarks local species such as *Liquidambar* *Styraciflua* diversify the alluvial formation, but along the Gasconade River there are no unusual species diversifying the area. Along the Gasconade River, *Hamamelis vernalis* is rare and local. On Piney River the very infrequent cottonwood is associated with silver maple and green ash.

The silver maple-cottonwood associates may completely succeed the willow-witch hazel associates if the rocky stream habitat of the latter becomes covered over with a rich alluvium favorable for the development of the former associates, or the two associates may exist as contiguous ones in relation to the alluvial formation of the stream.

The birch and the buttonbush sometimes come into the succession before the black willow, cottonwood, and silver maple have made

their appearance, and this may be explained by the greater ability of these two species to seed themselves in more gravelly and sandy stream bars. Along the Osage fork of the Gasconade River in Webster County, for example, river birch is absent as one of the associates of a later flood-plain succession. In this region Ward's willow and sycamore are dominant, being followed by black willow, silver maple, and green ash. On the Current River silver maple and poplar pioneer together as associate species in much the same way as they do in parts of areas of northeastern Missouri, as, for example, on Salt River.



FIG. 12. *Salix nigra*, instead of *Salix longipes* var. *Wardii*, pioneering on gravel. Along Moreau River, two miles southeast of Jefferson City, Cole County.

These first two associates of a flood-plain association are subject to sudden stream overflows and variation of water level. The herbaceous ground flora is, therefore, not varied, is late in developing, and is often composed of annuals or water-resistant types. There is practically no herbaceous or moss associates on the rocky habitat of the willow-witch hazel associates, but where a relatively large area of alluvial ground exists, with the silver maple-cottonwood associates are found a few dominant species on the forest floor, such as *Pilea pumila* var. *Deamii*, *Aster lateriflorus* var. *pendulus*, *Rudbeckia laciniata*, and white grass (*Leersia virginica*). Such mosses as *Amblystegium riparium* and *Leskea gracilescens* may be present.

After this stage of the flood-plain has been reached, the succession, once the deposit of alluvium has been formed, proceeds at a faster rate and more quickly reaches the climax types.

(3) The next stage, associated with the formation of richer soil over the original alluvium, is the American elm-green ash (*Ulmus americana*-*Fraxinus pensylvanica* var. *lanceolata*) associates (fig. 15). Sometimes, in places along the border counties of the Ozarks, *Fraxinus pensylvanica* var. *lanceolata* may pioneer on gravel bars with *Salix Wardii*, sycamore, and *Cephalanthus*—as on the Osage River in St. Clair and Benton counties. Another dominant in this phase of the succession is *Quercus Shumardii* (locally called water oak, otherwise named Shumard's red oak). Along Current and Black rivers, *Quercus Shumardii* is common in the *Ulmus americana*-*Acer saccharinum*-*Fraxinus pensylvanica* var. *lanceolata* formation, but on Gasconade and Piney rivers it is quite absent most of the time and found only occasionally. Bur oak (*Quercus macrocarpa*),



FIG. 18. Deposit of muddy alluvium above sand on bar on Little North Fork of White River, one and one-half miles south of Theodosia, Ozark County. Shows how a sand bar is gradually built up with a consequent new associates developing upon it.

box elder (*Acer Negundo*), and a few others also make their appearance in this stage, and in parts of the southeastern Ozarks, as along the Black and St. Francis rivers, sweet gum (*Liquidambar Styraciflua*) is found sometimes in this associates. The herbaceous associates on the forest floor is somewhat more varied than in the last associates, but stream overflows continue to occur in this associates likewise. Such herbs as honewort (*Cryptotaenia canadensis*), Virginia knotweed (*Polygonum virginianum*), beefsteak plant (*Perilla frutescens*), *Iresine rhizomatosa*, and *Calycocarpum Lyoni* are common, while the grass flora is dominated by spike grass (*Uniola latifolia*), fowl meadow

grass (*Glyceria striata*), giant cane (*Arundinaria gigantea*), and satin grass (*Muhlenbergia mexicana*). Along alluvial limestone banks at the base of bluffs, as along the Osage River in St. Clair County and elsewhere, *Uniola latifolia* and *Panicum virgatum* are dominant, associated with *Apocynum sibiricum* and *Leptochloa filiformis*. This is equivalent to pioneers on a mud stage, discussed under previous alluvial forms.



FIG. 14. *Acer saccharinum*-*Populus deltoides* associes on right side behind gravel bar, between Reed Springs and Viola, Stone County.

No *Arundinaria gigantea* occurs along the Gasconade, Osage, Piney, Meramec, Big, and Niangua rivers or their tributaries in the elm-ash stage or in other stages. The *Arundinaria* begins to appear on Black, Current, and other rivers where shaded alluvial banks and thickets occur. *Smilax Bona-nox* together with *Arundinaria* is common along the banks of White River.

After the third developmental stage (i.e. the American elm-green ash associes) has been attained, Ward's willow and button-bush, more or less shade-intolerant types, disappear, but sycamore, cottonwood, and black willow persist. In many alluvial associations in the western Ozarks, however, no cottonwood is present. Sometimes sugar maple also appears in the elm-ash associes, but does not become dominant until the last stage of the associes. This elm-ash associes may last indefinitely, and in some regions where the soil is flooded frequently and worn away or where the surrounding soil types are too acid, sugar maple may be prevented from entering this associes, and the elm-ash associes may become a temporary climax or subclimax.

Sometimes, in the Gasconade River region, silver maple and green ash together with sycamore are followed by birch-elm-ash-sycamore with maple, the two intergrading and slightly different from the situation which occurs in the southeastern Ozarks, where silver maple, cottonwood, and birch are often followed by elm and green ash, with birch, sycamore, and maple lingering over into the newer associates.



FIG. 15. *Ulmus americana*-*Fraxinus pensylvanica* var. *lanceolata* associates on alluvium of valley along Jacks Fork of Current River, north of Monteer, Shannon County. On top of the bluffs on the right are pine trees occurring on cherty and Roubidoux sandstone substrata.

In the southeastern Ozarks the usual succession is:

- (1) Ward's willow, witch hazel, sycamore, alder; succeeded by
- (2) silver maple, poplar, birch, black willow; succeeded by
- (3) elm, green ash.

In the White River country it is:

- (1) Ward's willow, witch hazel; succeeded by
- (2) black willow; succeeded by
- (3) silver maple, birch, elm, green ash.

In the Gasconade River area it is:

- (1) Ward's willow; succeeded by
- (2) sycamore, black willow; succeeded by
- (3) silver maple, green ash, birch; succeeded by
- (4) elm, silver maple.

But the end result is in all cases usually the same, i.e. with elm, silver maple, and green ash comprising the dominants in the associates. The elm comes in last in each case, but may have ash with it first or last, the ash being the varying pioneer.

Variations in Stage No. 3:

(a) On Piney Creek and other areas in Table Rock National Forest Purchase Unit in Barry and Stone counties, southwestern Missouri, instead of alder occurring with witch hazel in stage No. 1, *Ilex decidua* is found with witch hazel. The latter two plants are the dominants, together with such species as *Ostrya virginiana*, *Cornus obliqua*, *Cornus asperifolia*, and *Physocarpus opulifolius* var. *intermedius* (example No. 5).

(b) On Table Rock National Forest Purchase Unit in the White River country of southwestern Missouri, swamp privet (*Forestiera acuminata*) in stage No. 3 is scattered and sometimes is frequent along the banks with a characteristic alluvial stage of ash, elm, birch, and silver maple; in later associations it is often found with *Carpinus caroliniana* along steep river slopes (example No. 31). This same condition occurs on the St. Francis River near Chaonia on the Wapapella National Forest Purchase Unit in southeastern Missouri.

(c) At the base of steep slopes in the Table Rock National Forest Purchase Unit of southwestern Missouri, *Hamamelis vernalis* is common, but is not the dominant on gravel bars as it usually is elsewhere, for example, in the eastern and southern Ozarks. Instead, *Salix Wardii* and *Platanus* dominate the gravel bars. This is of interest, because *Hamamelis* is absent also to the east, on the larger streams, but is present on the smaller ones.

(d) On the Niangua River, on the Little Pomme de Terre River, and on the Osage Fork of Gasconade River near Rader in Webster County, there is no birch, alder, or poplar in the alluvial formation. Instead, one finds that Ward's willow or Ward's willow and sycamore are followed by black willow and green ash, and then elm.

(e) On the Gasconade River, in stage 2, instead of sycamore and black willow as co-dominants, there are sycamore, black willow, sand-bar willow (*Salix interior*), birch, and *Ampelopsis cordata*. Birch may be entirely absent from the associates, for example, along the Osage Fork of the Gasconade River in Webster County.

(f) In the southeastern Ozarks sycamore appears at the very beginning of the succession with *Salix Wardii* and witch hazel (examples Nos. 1, 2, 9, and 10), but on the Gasconade River sycamore follows *Salix Wardii* or *S. interior* and is usually mixed with black willow.

(g) Along the northern border of the Ozark region the black willow pioneers on the gravel at the very beginning of the succession instead of *Salix longipes* var. *Wardii*. The latter is here near its

northern limit of dispersal in the Ozarks and its place is taken by *Salix nigra* (fig. 12).

(h) Silver maple, elm, and green ash are usually associated at the end of the flood-plain succession in the Gasconade and Piney river areas.

Rosa setigera var. *tomentosa* is frequent along the river banks in all the areas. *Vitis cordifolia* and *V. cinerea*, especially the latter, are the common vines in this alluvial formation, but *Ampelopsis cordata* and *Parthenocissus quinquefolia* also occur frequently. *Aristolochia tomentosa* is common all along the Gasconade, Piney, Black, Current, and White rivers in the alluvial formation. Variations on the Gasconade River are found in the pioneering frequencies of either *Salix Wardii* or *S. interior*, the former pioneering on direct gravel, the latter where more sandy mud has accumulated instead of gravel. Both species may grow on the same river bar.

Thus far, we have discussed the succession only among the trees and shrubs of the various associates of the flood-plain formation (*Acer saccharum*—*Carya cordiformis* association). The herbaceous succession in this formation is:

- (1) Water willow (*Dianthera americana*); succeeded by
- (2) *Scirpus americanus* or *Sagittaria latifolia* in back of water willow; succeeded by
- (3) *Leersia oryzoides* and *Echinochloa pungens*.

Associated with the above dominant species in stage No. 3 are:

Bidens polylepis
Panicum capillare
Panicum dichotomiflorum
Panicum Gattingeri

Polygonum pensylvanicum
Polygonum punctatum
Xanthium chinense
Xanthium pensylvanicum

On more sandy soil, *Scirpus americanus*, *Lobelia cardinalis*, and *Eupatorium coelestinum* occur directly behind water willow, while *Sagittaria latifolia* grows on more muddy soil behind water willow. *Rotala ramosior* var. *interior* is found usually on muddy alluvium. Sometimes along the border counties of the Ozarks, as along the Osage River in St. Clair County, occur on the muddy bar *Acnida tamariscina*, *Ampelamus albidus*, *Xanthium pensylvanicum* and *X. chinense*, *Echinochloa pungens*, *Polygonum coccineum*, *P. lapathifolium*, and others, *Lippia lanceolata*, *Lindernia dubia*, *Ammannia coccinea*, and *Leptochloa filiformis*. Just within the *Xanthium* formation or behind it is *Hibiscus lasiocarpus*. In shaded alluvium, back of *Xanthium*—*Leersia* association occur:

Acalypha rhomboidea
Ambrosia trifida
Eupatorium coelestinum
Impatiens biflora

Perilla frutescens
Pilea pumila var. *Deamii*
Polygonum punctatum
Verbena urticaefolia

Along the Osage River in Miller County water willow is followed by an association of the following herbaceous plants: *Setaria lutescens*, *Panicum virgatum*, *P. capillare*, *Polygonum pensylvanicum*, *Euphorbia supina* (*E. maculata* of authors), and *E. serpens*. Back of the gravel accumulates an alluvial deposit of muddy soil dominated by the following plants: *Xanthium chinense*, *Polygonum pensylvanicum*, *Spermacoce glabra*, *Euphorbia maculata* (*E. nutans* of authors), *Ipomoea lacunosa*, and *Panicum dichotomiflorum*.

The herbaceous element changes as one goes from an alluvial type of woods to one with a development of more humus on the alluvial bottoms and slopes. Thus, in stage No. 1 on the moist alluvial banks along the Gasconade River the dominant species are:

Stage No. 1

Agrostis perennans
Cinna arundinacea
Elymus virginicus

Leersia virginica
Muhlenbergia sp.

Associated with the species in stage No. 1 are:

Campsis radicans
Panicum clandestinum
Phlox divaricata var. *Laphamii*
Pilea pumila var. *Deamii*
Ruellia strepens
Solidago serotina

Spermacoce glabra
Symphoricarpos orbiculatus
Ulmus americana
Uniola latifolia (on Black River)
Viola papilionacea
Xanthium pensylvanicum

Elymus virginicus is a dominant species along the banks of streams in the White River country.

Stage No. 2, on higher but still flat, alluvial ground, consists of the following species, developed in a woodland consisting principally of silver maple and green ash:

Stage No. 2

Acalypha rhomboidea
Acer Negundo
(young plants)
Acer saccharinum
(young plants)
Aster lateriflorus var. *pendulus*
Benzoin aestivale
(occasional; young plants)
Bidens frondosa
Boehmeria cylindrica
Cinna arundinacea
Commelina virginica
Dicliptera brachiata
(occasional)
Echinocystis lobata
Fraxinus pensylvanica var. *lanceolata*
(young plants)
Impatiens biflora
Iresine rhizomatosa
Mimulus alatus

Perilla frutescens
(rare)
Polygonum punctatum
(occasional)
Polygonum virginianum
Quercus macrocarpa
(occasional; young plants)
Rudbeckia laciniata
Ruellia strepens
Sambucus canadensis
(occasional; young plants)
Scutellaria lateriflora
Smilax hispida
Solanum nigrum
Solidago serotina
Toxicodendron radicans
(young plants)
Vernonia altissima
Viola papilionacea
Vitis cordifolia

The species listed above are in the type of woods described for the silver maple-cottonwood associates of southeastern Missouri.

Beginning with stage No. 3, where the base of the slope begins with a richer, better-drained soil, the herbaceous flora changes to an abundant and luxuriant growth of the following species:

Stage No. 3

<i>Amphicarpa bracteata</i>	<i>Geum canadense</i> var. <i>camporum</i>
<i>Asarum canadense</i>	<i>Impatiens pallida</i>
<i>Asimina triloba</i>	<i>Laportea canadensis</i>
(young plants)	<i>Menispermum canadense</i>
<i>Blephilia hirsuta</i>	<i>Parthenocissus quinquefolia</i>
<i>Carya cordiformis</i>	<i>Phytolacca americana</i>
(young plants)	<i>Sanguinaria canadensis</i>
<i>Cystopteris fragilis</i> var. <i>protrusa</i>	<i>Tilia glabra</i>
<i>Eupatorium purpureum</i>	(young plants)
<i>Eupatorium urticaefolium</i>	<i>Verbesina virginica</i>
<i>Euonymus atropurpureus</i>	<i>Viola eriocarpa</i> var. <i>leiocarpa</i>
(young plants)	<i>Viola striata</i>
<i>Galium triflorum</i>	

As the richer slopes are ascended into drier, rockier ground, there is a thinning out of alluvial species such as *Leersia virginica*, *Rudbeckia laciniata*, *Eupatorium coelestinum*, *Aster lateriflorus* var. *pendulus*, and *Pilea pumila* var. *Deamii*. Their places are taken by the following species:

<i>Carex blanda</i>	<i>Quercus alba</i> f. <i>latiloba</i>
<i>Carpinus caroliniana</i>	(young plants)
(young plants)	<i>Quercus borealis</i> var. <i>maxima</i>
<i>Carya cordiformis</i>	(young plants)
(young plants)	<i>Sassafras albidum</i> var. <i>molle</i>
<i>Celtis occidentalis</i> var. <i>canina</i>	(young plants)
(young plants)	<i>Scutellaria ovata</i>
<i>Circaea latifolia</i>	<i>Symphoricarpos orbiculatus</i>
<i>Cystopteris fragilis</i> var. <i>protrusa</i>	(young plants)
<i>Dioscorea villosa</i>	<i>Ulmus fulva</i>
<i>Fraxinus americana</i>	(young plants)
(young plants)	<i>Verbena urticaefolia</i>
<i>Phlox divaricata</i> var. <i>Laphamii</i>	

On some slopes covered with talus at this stage the herbaceous cover is dominated by *Impatiens pallida*, *Hydrophyllum appendiculatum*, *Viola eriocarpa* var. *leiocarpa*, *Podophyllum peltatum*, *Circaea latifolia*, *Menispermum canadense*, and *Asarum canadense*. Farther up the talus, where rocks are nearer the surface and more plentiful, *Polymnia canadensis* is dominant and may cover the ground solidly for more than half the way up. *Staphylea trifolia* is the dominant shrub on the talus one-fourth to one-half the way up, while on the lower, richer slopes, as the final climax stage, *Carya cordiformis* is dominant. *Tradescantia Ernestiana* is one of the herbaceous dominants of the rich slopes in the region of White River and its

tributaries in southwestern Missouri, but is not found elsewhere in the state.

As the soil becomes richer and richer and gradually builds up a deeper humus layer mixed with rich, sandy alluvium, a greater number of trees, but particularly shade-tolerant shrubs, appear.

(4) This final developmental stage is dominated by sugar maple and bitternut hickory (*Carya cordiformis*), and the associates may be called the sugar maple-bitternut hickory associates. One or two understories of shrubs are usually found in this associates. The paw-paw (*Asimina triloba*) and American hornbeam or ironwood (*Carpinus caroliniana*) are dominant small trees forming an upper portion of the understory, while buck brush or coralberry (*Symphoricarpos orbiculatus*) is a dominant lower understory shrub. Flowering dogwood (*Cornus florida*) is often very abundant, as is also spicebush (*Benzoin aestivale*) and greenbrier (*Smilax hispida*). Along the tributaries of Black River, especially in the southeastern half of the Clark National Forest Purchase Unit, leatherwood (*Dirca palustris*) becomes a conspicuous shrub of the lower understory (examples Nos. 43 and 46). It is conspicuous also along Noblett and Indian creeks in Howell and Douglas counties. These creeks drain into the North Fork of White River in southern Missouri. Other trees and shrubs found commonly in the final stage of this flood-plain association are, in order of abundance:

Black walnut (<i>Juglans nigra</i>)	Hackberry (<i>Celtis occidentalis</i>)
Chinquapin oak (<i>Quercus Muhlenbergii</i>)	Bur oak (<i>Quercus macrocarpa</i>)
White oak (<i>Quercus alba</i>)	Winged elm (<i>Ulmus alata</i>)
Sour gum (<i>Nyssa sylvatica</i>)	Red-flowered buckeye (<i>Aesculus discolor</i> var. <i>mollis</i>)
Hazelnut (<i>Corylus americana</i>)	Bladdernut (<i>Staphylea trifolia</i>)
Butternut (<i>Juglans cinerea</i>)	Hop hornbeam (<i>Ostrya virginiana</i>)
Red mulberry (<i>Morus rubra</i>)	Elderberry (<i>Sambucus canadensis</i>)
Shingle oak (<i>Quercus imbricaria</i>)	Black haw (<i>Viburnum rufidulum</i>)
Redbud (<i>Cercis canadensis</i>)	Chittim-wood (<i>Bumelia lanuginosa</i>)
Several species of hawthorn (<i>Crataegus</i>)	Moonseed (<i>Menispermum canadense</i>)
Linden (<i>Tilia glabra</i>)	Fragrant sumac (<i>Rhus aromatica</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Black cherry (<i>Prunus serotina</i>)
Honey locust (<i>Gleditsia triacanthos</i>)	Ohio buckeye (<i>Aesculus glabra</i> var. <i>pallida</i>)

Red-flowered buckeye, found in rich, alluvial woods, is common only in the southeastern section of the state.

Some of the species mentioned above, namely, linden, white oak, chinquapin oak, northern red oak, black walnut, butternut, and sour gum, seem to have invaded the final stages of this associates by an incursion from the adjacent rich lower regions at the base of limestone bluffs or slopes where they were originally part of the

climax flora of these areas and having descended the ravines and slopes of the limestone areas gradually merged with the climax vegetation of the alluvial association (fig. 16). They may be considered a post-climax of the flood-plain association.

Sycamore is a very common species throughout the flood-plain development and persists into the very last associates. Together with elm and ash, sycamore and sugar maple are the dominant species in the final associates of the flood-plain flora. Birch likewise persists, but in a rich flood-plain is commonest adjacent to the river. Black



FIG. 16. Along Huzzah Creek, two miles southeast of Davisville, Crawford County.

willow and buttonbush do not persist into this final stage, but are represented here and there by isolated plants, usually near the water's edge.

Some of the herbaceous species common on the forest floor of the final flood-plain stage are:

Actinomeris alternifolia
Amphicarpa bracteata
Asarum canadense var. *acuminatum*
Blephilia hirsuta
Cystopteris fragilis var. *protrusa*
Dioscorea villosa
Eupatorium purpureum
Eupatorium urticaefolium
Galium triflorum
Geum canadense var. *camporum*
Impatiens pallida and *I. biflora*
Laportea canadensis
Lappula virginiana

Parthenocissus quinquefolia
 (young plants)
Passiflora lutea
Perilla frutescens
Phlox divaricata var. *Laphamii*
Phytolacca americana
Pilea pumila var. *Deamii*
Ranunculus abortivus
Sanguinaria canadensis
Sicyos angulatus
Toxicodendron radicans
Verbesina virginica
Viola eriocarpa
Viola striata

Sometimes the herbaceous flora of the rich wooded alluvium of the final stage will be found in the stage preceding. The two intergrade into their floral components, with a greater variety finally appearing in the final stage. The herbaceous ground flora associates of this final stage is very poorly represented, the spring flora being best developed.

II. SUGAR MAPLE-WHITE OAK ASSOCIATION

(*Acer saccharum-Quercus alba*)

The next association of the deciduous forest climax formation to be discussed is the sugar maple-white oak association. In its final developmental stages the flora of this association approaches closely



FIG. 17. Limestone glade along Niangua River, two miles south of Corkery, Dallas County.

the composition of the flood-plain association of sugar maple-bitternut hickory. The two arrive at nearly the same climax, namely, the mesophytic, deciduous forest, because the climatic climax is a mesophytic one, but the flood-plain association (sugar maple-bitternut hickory) begins as a hydrosere (its initial stage beginning in or near water), while the other (sugar maple-white oak) association begins as a xerosere (its initial stages beginning where there exists an extreme deficiency of water, as on bare limestone glades or exposed, rocky bluffs).

(1) The first stage takes place on bare, rocky, limestone glades or openings where the rock is exposed and the residual fragments are everywhere conspicuous. An herbaceous flora with largely a component of prairie species covers the glade (fig. 17). This first stage is

usually represented by the side-oats grama-perennial black-eyed Susan (*Bouteloua curtipendula*-*Rudbeckia missouriensis*) associates. In other portions of the Ozarks, as in some of the Ozark border counties, i.e. Benton County along the Osage River, *Silphium laciniatum* and *Psoralea tenuiflora* are dominant instead of *Rudbeckia missouriensis*, and occur with the co-dominant *Bouteloua curtipendula* (fig. 18). In other Ozark glades, as in the border counties of the Ozarks or in places where a rich prairie or grass flora covers open slopes, one finds *Andropogon provincialis* very common and co-dominant with *Bouteloua curtipendula*. Many other herbaceous plants are commonly found. The changing aspects of the glade are the result of the spring, summer, and autumn societies of plants. In the spring there are



FIG. 18. Limestone glade with dominants of *Silphium laciniatum*, *Psoralea tenuiflora*, and *Bouteloua curtipendula* on bluffs along Osage River, two miles northwest of Wisdom, Benton County.

societies of Missouri primrose (*Oenothera missouriensis*), blue wild indigo (*Baptisia minor*), sandwort (*Arenaria patula*), wild hyacinth (*Camassia scilliioides*), *Leavenworthia uniflora*, purple cone-flower (*Echinacea pallida*), yellow cone-flower (*Echinacea paradoxa*), *Galium virgatum*, and many others. In summer the conspicuous dominants are *Houstonia nigricans*, false aloe (*Agave virginica*), *Evolvulus Nuttallianus* (mostly in western Missouri), *Petalostemum purpureum*, *Centaureum texense* (in western Missouri), *Heliotropium tenellum*, *Tragia urticaefolia*, *Croton capitatus*, and calamint (*Satureja glabella* var. *angustifolia*). In the autumn the prevailing species are *Aster oblongifolius*, *A. sericeus*, wild onion (*Allium stellatum*), and perennial black-eyed Susan (*Rudbeckia missouriensis*). *Panicum*

virgatum, melic grass (*Melica nitens*), and big and little blue-stem (*Andropogon provincialis* and *A. scoparius*), together with side-oats grama (*Bouteloua curtipendula*), predominate among perennial grasses, while *Sporobolus vaginiflorus*, *S. neglectus*, and *Panicum capillare* predominate among annual grasses. *Sporobolus vaginiflorus* is a much more common and dominant grass over the balds of southwestern Missouri than it is on the eastern Ozark glades.

Herbaceous species found on the glades of the western Ozarks which are common in addition to the ones given below are *Palafoxia callosa*, *Linum sulcatum*, *Polytaenia Nuttallii*, and *Parthenium hispidum*. *Berchemia scandens* is often found. The *Tragia*, *Pala-*



FIG. 19. Red cedar glade or bald on dolomitic limestone, near Taney County line, in Stone County.

foxia, *Berchemia*, and *Baptisia* are much more characteristic of and some are altogether confined to the western and southwestern Missouri glades and bald knobs.

This first stage was the original condition which existed all over the Ozarks in limestone areas following uplifts. Then the gradually elevated, rocky terrain first became carpeted with an herbaceous flora such as is now found on eroded glades. As will be noted from what follows, the limestone glades have been and are gradually losing ground, i.e. are becoming covered by the forest (figs. 19, 20, 21, 24, and 25). In other words, *the natural succession, under the present mesophytic climatic climax, is towards a forest which sooner or later obliterates the glade.*

This pioneer herbaceous stage may last indefinitely. Those glades and eroded limestone slopes facing west or south remain

exposed longer than those facing east or north, because the dry sun and windswept conditions existing on such slopes are much more favorable for the development of an herbaceous flora than for a forest coverage (figs. 19, 20, and 21). The glade covering is too sparse and open to permit good windbreaks to hold leaves for decay, and those leaves which do remain are quickly scorched and dried in the sun so that leaf decay, rock disintegration, and soil formation proceed at a very slow rate. On east- and north-facing areas, more moisture and protection against prevailing winds exist, and soil building goes on at a relatively faster pace. Thus the succession taking place on north- and east-facing slopes culminates in the climax sugar maple-white oak associates at a relatively more rapid rate when compared with that taking place on a south- and west-facing area.

(2) The next stage to follow the pioneer herbaceous flora is usually initiated by the glade variety of fragrant sumac (*Rhus trilobata* var. *serotina*) and is soon joined by its associates, red cedar

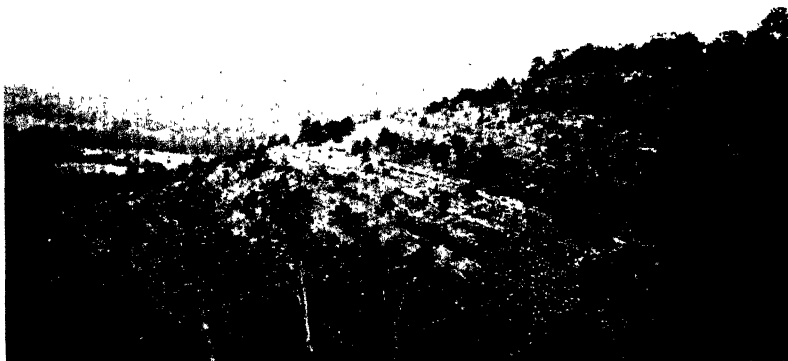


FIG. 20. Bald knob west of Table Rock, west of Branson, Taney County.

(*Juniperus virginiana*) and persimmon. Any one of these may be dominant, but red cedar in most cases becomes the most conspicuous member and often forms a consociation by itself (fig. 19). "Cedar glades" are a common, characteristic feature of eroded limestone slopes and knobs (figs. 19 and 20). The ground cover is sparse under the red cedars and in a red cedar forest. Melic grass (*Melica nitens*), *Panicum virgatum*, and big and little blue-stem are grasses usually found in open areas in this associates. Some mosses, such as *Orthotrichum Porteri* and species of *Grimmia*, occur on the bare, exposed rocks.

Red cedar is dominant in the eastern Ozarks and in the country bordering the Piney and Gasconade River region, but on the bald knobs and bare limestone areas in the White River region of southwestern Missouri persimmon is often the pioneer and dominant species. On these balds, persimmon (fig. 21) or cedar is first, or the two occur simultaneously, and around shade in thickets at the same time occur *Rhus trilobata* var. *serotina*, *Symphoricarpos orbiculatus*, and *Smilax Bona-nox*. Sassafras sometimes grows as a pioneer with persimmon, especially if there is more chert in the rock. Then follows *Bumelia lanuginosa* (fig. 22) succeeded by the *Cotinus americanus*—



FIG. 21. *Diospyros virginiana* initiating woody growth on limestone glade along Niangua River, two miles south of Corkery, Dallas County.

Quercus Muhlenbergii stage, which is associated with *Quercus Shumardii* var. *Schneckii*, *Rhus trilobata* var. *serotina*, *Cercis canadensis*, and *Chionanthus virginica* (example No. 49). On some of the dolomitic limestone glades and knobs here, persimmon and *Rhus trilobata* var. *serotina* appear to be the pioneers, with cedar absent or suppressed. If this happens, *Cotinus* and *Quercus Muhlenbergii* follow the cedar-*Rhus trilobata* var. *serotina* stage, without the occurrence of cedar. With persimmon are also *Ulmus alata* and *Bumelia lanuginosa*, and sometimes *Viburnum rufidulum*, but *Rhamnus caroliniana* and *Chionanthus virginica* are later in the succession than *Quercus Muhlenbergii* or *Cotinus*, or infrequently come at the same time. *Aster oblongifolius* is common on the glades, while *Aster sericeus* is rare. In some places persimmon and cedar alone occur, while in others persimmon, cedar, and winged elm dominate. Sassafras is often dominant with persimmon on some of the bald knobs. Along draws in the limestone

glade the most common pioneering plants are *Physocarpus*, *Andrachne*, *Ilex decidua*, *Rhamnus caroliniana*, *Cornus obliqua*, and *C. asperifolia*. These draws may occur in slight depressions or valleys between the balds or may occur on a slope. *Chionanthus* appears around draws and drainage crevices and occurs as a substory with *Cotinus*, *Cornus florida*, *Acer saccharum*, *Ilex decidua*, *Cornus asperifolia*, *Quercus Shumardii* var. *Schneckii*, *Rhamnus caroliniana*, and *Physocarpus*.

The normal glade, thus far discussed, in most of the Ozarks, including the last two stages discussed, is still open, but gradually becomes forested (figs. 23, 24, and 25); with the incursion and development of red cedar and persimmon, the rocks become covered by leaves. This next stage of development results when the trees gain a foothold and thereby serve as windbreaks with consequent leaf preservation on the ground. With the gradual rock disintegration



FIG. 22. *Quercus Muhlenbergii* invading an associates with *Diospyros virginiana* and *Bumelia lanuginosa* along the bluffs of Osage River (Lake-of-the-Ozarks), at Riverview, Morgan County.

and increase of soil, an incursion of various shrubs appears, and the third stage of the succession follows.

(3) This is the chittim-wood-black haw (*Bumelia lanuginosa*-*Viburnum rufidulum*) associates. While these two species are dominant, others also may be abundant and these are usually greenbrier (*Smilax Bona-nox*), supplejack (*Berchemia scandens*), and species of hawthorn (*Crataegus*) or hackberry (*Celtis pumila* var. *georgiana* or *C. laevigata* var. *texana*).

Once this stage has been reached, other shrubs and trees rapidly begin to take possession, and red cedar, once so conspicuous on the glade, gradually loses ground.

(4) An associates that usually follows is that of the winged elm-Indian cherry (*Ulmus alata*-*Rhamnus caroliniana*). Associated with these species usually is the southern hackberry (*Celtis laevigata* var. *texana*), stunted specimens of white ash (*Fraxinus americana*), and possum haw (*Ilex decidua*).

(5) This is quickly followed by the next associates, chinquapin oak-white ash (*Quercus Muhlenbergii*-*Fraxinus americana*), which



FIG. 23. *Quercus Muhlenbergii*-*Fraxinus americana* associates dominating grassy slopes along headwaters of Bryant Creek, two miles southeast of Cedar Gap, Wright County. Shows incursion of forest over prairie-glade slopes with gradual elimination of the latter.

dominates west- and south-facing slopes. In the eastern and southeastern Ozarks the chinquapin oak-white ash stage appears as one associates, but on the White River bald knobs this stage is equivalent to the chinquapin oak-*Cotinus* associates discussed previously. The chinquapin oak-white ash associates has a rich variety of other trees and shrubs, among which may be found hop hornbeam (*Ostrya virginiana*), redbud, slippery elm (*Ulmus fulva*), *Quercus Shumardii* var. *Schneckii* (a variety of red oak sometimes confused with Texas red oak), and blue ash (*Fraxinus quadrangulata*). Greenbrier, as well as species from the preceding associates, such as black haw (*Viburnum rufidulum*), winged elm (*Ulmus alata*), and hop hornbeam usually occur in this associates (fig. 28). Sometimes blue ash is much more conspicuous in portions of the Ozarks along limestone bluffs

and becomes a dominant species, forming an associates with *Bumelia lanuginosa*, immediately following an occupation by *Viburnum rufidulum*, *Rhamnus caroliniana*, and *Rhus trilobata* var. *serotina*, or else occurring simultaneously with them. On west- and south-facing slopes and bluffs this associates may last indefinitely and form more or less of a climax or subclimax stage, the arrested development characterizing such a subclimax being due to exposed conditions which favor the persistence of such a flora. Chinquapin oak is particularly abundant in such exposures. On the more rocky slopes in this associates, a temporary substory of winged elm, hop hornbeam, black haw, and *Bumelia lanuginosa* may appear dominant but is finally superseded in the following climax forest associates, where these species become inconspicuous. On rocky slopes in this and the following stage with sugar maple, *Brickellia grandiflora* may frequently be dominant. At this stage the herbaceous flora is dominated on the rocky lime-



FIG. 24. Bald knob, just east of McClurg, Ozark County. Showing the *Acer saccharum*-*Quercus alba* climax reached in the development of a limestone substratum, and the covering of the glade by forests of this climax stage.

stone slope by *Pilea pumila* var. *Deamii*, *Impatiens pallida* and *I. biflora*, *Hydrophyllum appendiculatum*, *Campanula americana*, and *Polymnia canadensis*. This may, however, be a derived condition brought on by burning. At this stage a sedge (*Carex eburnea*) usually occurs in the bluff crevices where a slight accumulation of soil exists, and grows with mosses such as *Rhodobryum roseum* and *Thuidium minutulum*. A great variety of grasses is present at this stage among the ledges and rock exposures where soil has accumulated. They include species of *Muhlenbergia*, *Brachyelytrum erectum*, *Uniola*

latifolia, wild rye (*Elymus virginicus*), chess (*Bromus purgans*), fescue (*Festuca obtusa*), bottlebrush (*Hystrix patula*), and *Sphenopholis intermedia*.

On the edges of bluffs (fig. 22) in associates Nos. 2, 3, 4, or 5 of *Quercus Muhlenbergii*-*Fraxinus americana* or *Bumelia*-*Diospyros* is an herbaceous flora characterized by:

Allium mutabile
Asclepias stenophylla
Euphorbia (zygophylloides) missurica
Heleotropium tenellum
Helianthus Maximiliani
Houstonia nigricans
Isanthus brachiatus
Liatris cylindracea

Malvastrum angustum
Mentzelia oligosperma
Mirabilis albidus
Psoralea tenuiflora
Scutellaria parvula
Solidago Drummondii
Solidago radula



FIG. 25. Three miles northwest of Vichy, Maries County. Similar to Fig. 24, except that forest of *Acer saccharum*-*Quercus alba* associates has more nearly closed the originally open glade. Cf. Figs. 24 and 25 with Figs. 19, 20, and 21.

These open bluff slopes may vary in their herbaceous composition according to the amount of chert or limestone present, the amount of lime which has been eroded, and other factors. If there is much more chert than lime present, acidity prevails and *Polygonum tenue*, *Acalypha gracilens* var. *monococca*, *Linum medium* var. *texanum*, *Psoralea psoralioides* var. *eglandulosa*, *Stylosanthes biflora* var. *hispidissima*, *Lechea tenuifolia*, *Crotonopsis elliptica*, *Scleria pauciflora*, and *Crotalaria sagittalis* predominate; while, if limestone predominates, limestone-loving species occur, such as *Malvastrum angustum*, *Isanthus brachiatus*, *Heliotropium tenellum*, *Houstonia nigricans*, *Linum sulcatum*, *Helianthus Maximiliani*, *Allium mutabile*, *Euphorbia (zygophylloides) missurica* (in the western Ozarks), *Verbena simplex*, *Asclepias stenophylla*, and *Mentzelia oligosperma*.

Species commonly occurring along the edges of the bluffs are *Solidago radula*, *S. Drummondii*, *Liatris squarrosa*, *L. cylindracea*, and sometimes on very high, exposed situations of west- or south-facing bluffs are *Arenaria stricta* var. *texana* and *Muhlenbergia cuspidata* (fig. 16).

Some of this flora is, of course, persistent from the original type which occurred on the limestone glade in the beginning while yet a part of the original cover. This is true of the types not on the very edge of the bluff. The very edge of the bluff has distinctive groups of species, such as *Solidago Drummondii*, *S. radula*, and *Liatris cylindracea*, which are usually not on the open or more level parts of the glade proper.

(6) At the beginning of this last associates, sugar maple makes its appearance. Not until sufficient soil has accumulated on the limestone exposures does it usually penetrate the area, although very



FIG. 26. *Acer saccharum*-*Quercus alba* climax associates, well developed over a limestone substratum, Taney County.

little soil is needed to induce it to appear frequently. It is much more abundant on north- and east-facing slopes at the same stage when chinquapin oak is dominant on south- and west-facing ones. Often on these south- and west-facing slopes it may be almost as common as chinquapin oak. As more soil is formed over the limestone substratum which originally was an open glade (figs. 24 and 25), sugar maple becomes commoner, and finally attains a dominance, forming, with white oak, the last stage of development, the sugar maple-white oak associates. On north- and east-facing slopes sugar

maple becomes the dominant species. The common species of trees in this climax associates are white oak (*Quercus alba*), northern red oak (*Quercus borealis* var. *maxima*), linden (*Tilia glabra*), and butternut (*Juglans cinerea*). These north-facing limestone slopes produce the climax mesophytic forest with white oak, northern red oak, and sugar maple dominating. Usually on such north-facing slopes the lower portions are covered by linden, northern red oak, and white oak, while on the upper slopes northern red oak and sugar maple are usually dominant (fig. 26).

The dominant understory in this climax associates of sugar maple-white oak consists of flowering dogwood and American hornbeam or



FIG. 27. Bluffs along White River just west of Shreiner's Ferry, Barry County, showing at left all stages of succession from a gravel bar in the initial development of a flood-plain association to the final stage (*Acer saccharum-Quercus alba*) of the development over an eroded limestone bluff or open glade.

ironwood (*Carpinus caroliniana*), while a lower story may be composed of spicebush (*Benzoin aestivale*) and bladdernut (*Staphylea trifolia*). As the soil becomes richer, deeper, and consequently of greater water-holding capacity, these shrubs in the climax associates succeed in becoming dominant over those of the preceding associates, i.e. hop hornbeam, winged elm, black haw (*Viburnum rufidulum*), and *Bumelia lanuginosa*, the understory once dominant on drier exposures. In some portions of the southeastern Ozarks the running strawberry-bush (*Euonymus obovatus*) and the eastern witch hazel (*Hamamelis virginiana*) (examples Nos. 78, 79, 80, and 101) may be locally dominant in the understory flora of north- and east-facing limestone slopes.

Variations in Stage No. 6:

(a) In some portions of the Ozarks, *Cornus florida* and *Staphylea* are dominant as a substory, while in other parts they are not. In certain parts of the western Ozarks, as in the Swan Creek territory of Christian County, *Viburnum molle* is a local co-dominant in a sugar maple-chinquapin oak-northern red oak woods as a substory



FIG. 28. Bee Bluff, along Current River, northeast of Eminence, Shannon County, showing the development of vegetation over a limestone bluff.

co-dominant with pawpaw, *Carpinus*, *Benzoin*, and *Staphylea* (example No. 70), while black maple (*Acer nigrum*) often becomes a local dominant (example No. 71) instead of sugar maple on rich, north-facing slopes along Bull Creek, Christian County, along Swan Creek in Christian and Taney counties (examples Nos. 69 and 70), Montauk Spring Branch, in Dent County, some portions of the Gasconade River in Pulaski County (example No. 89), and Bryant Creek in Wright and Douglas counties. In this case the climax is

made up of black and sugar maple, linden (*Tilia glabra*), and northern red oak.

(b) Similarly, *Cornus alternifolia* becomes a local substory co-dominant with *Staphylea* on north-facing slopes in certain parts of the eastern Ozarks, as at Montauk State Park, Dent County (example No. 94), Bee Fork of Black River, Reynolds County, certain parts of the Gasconade River in Pulaski County, certain places along the North Fork of White River in Douglas County, Bryant Creek in Wright County, along portions of Jacks Fork of Current River and tributaries in Shannon and Texas counties, and along Noblett and Spring creeks in parts of northwestern Howell County.

(c) Sugar maple is often dominant with chinquapin oak on west- and south-facing areas rather than with red oak in the White River region of southwestern Missouri. *Morus rubra*, *Quercus Muhlenbergii*, and *Celtis occidentalis* are dominant on south- and west-facing areas. On areas in the chinquapin oak-sugar maple association in the White River region, *Cladrastis lutea* is associated with *Ulmus americana*, *Cercis*, *Celtis occidentalis*, *Morus rubra*, pawpaw, benzoin, *Symphoricarpos*, *Viburnum rufidulum*, and *Juglans nigra* (example No. 66). In this association *Yucca arkansana* occurs in association with *Smilax Bona-nox*, *Elymus virginicus*, and *Berchemia*. In the White River area *Robinia Pseudo-Acacia* is native and part of the substory with pawpaw, benzoin, and redbud in the sugar maple-northern red oak-chinquapin oak area, and occurs at the base of bluffs on rich slopes. This *Robinia* with its associates may be placed also in the final stage of the alluvial associations.

(d) White oak is not part of the dominant last associates in this final association in the White River area. The east-facing slopes are dominated by sugar maple, northern red oak, linden, *Juglans cinerea* (all found in the eastern Ozarks), as well as *Celtis occidentalis*, with the lower story or substory dominated by *Staphylea*, pawpaw, and *Carpinus*, as in the eastern Ozarks. Dogwood, which is a dominant in substory in the eastern Ozarks, practically does not occur here.

(e) All these local dominants are found only in certain areas, and their distribution is limited. They do not enter the picture in all the plant successions within the Ozarks. For example, along Pomme de Terre River in Hickory County, *Carpinus* becomes less abundant and *Staphylea* and pawpaw predominate.

(f) On north- and east-facing limestone slopes where the climax type is reached, the herbaceous flora may be dominated by liverleaf

(*Hepatica acutiloba*), early meadow rue (*Thalictrum dioicum*), and thin grass (*Agrostis perennans*). Various mosses, such as *Mnium cuspidatum* and other species of *Mnium*, *Platygyrium repens* and *Orthotrichum pusillum*, may be common in this associes.

(g) The herbaceous flora may have also *Bromus purgans*, *Festuca obtusa*, *Hystrix patula*, *Osmorhiza Claytoni*, *Athyrium pycnocarpon*,



FIG. 29. Bee Bluff, along Current River, northeast of Eminence, Shannon County, in the southeastern Ozarks; showing the development of vegetation on a limestone bluff.

Sanicula canadensis, *Actaea pachypoda*, *Eupatorium urticaefolium*, and *Veratum Woodii*. *Thalictrum dioicum* is locally dominant on rich, north-facing slopes along Swan Creek, Christian County, Bee Fork, Reynolds County, some parts of the Gasconade River in Pulaski County, some parts of White and James rivers in Stone, Taney, and Barry counties, some parts of the Osage River in St. Clair County, and elsewhere in the Ozarks.

The climax development of a limestone slope will, therefore, be seen to simulate mostly the climax associates of a flood-plain development, the most common element in both being sugar maple. In both associations ironwood (*Carpinus caroliniana*) and flowering dogwood are conspicuous members of the understory. The one association begins as a hydrosere while the other starts as a xerosere, yet each ends in the climatic mesophytic climax. Since sugar maple favors alkaline to neutral soils, it naturally is found in both associations; in the flood-plain the development appearing on the richest



FIG. 30. Limestone bluffs along Eleven Points River, near mouth of White Creek, Oregon County, showing somewhat more advanced stage of cover than in Figs. 28 and 29.

alluvial climax soils, while on the limestone slope development it responds to the calcareous soils.

Likewise there is much interchange and overlapping of floras of the two preceding climax associations, particularly where the flora of the rich lower portions of the limestone slopes merges into that of the flood-plain flora. This is conspicuous in the case of such plants as pawpaw, bitternut hickory (*Carya cordiformis*), leatherwood, butternut, spicebush (*Benzoin aestivale*), buck brush (*Symphoricarpos orbiculatus*), and linden (*Tilia glabra*). These species occupy the lower slopes of the limestone flora, and occur also in the climax associates of the flood plain.

It should be borne in mind that one limestone hillside may show all stages of the succession. Very often most of the hillside will have reached a stage where most of the slope is covered with fairly deep soil and is well forested except for a few exposed rock outcrops

(fig. 27). The species of the deeper soil adjacent to the rock outcrops are constantly pioneering on any new portions of the outcrop or glade where some soil is available so that they can gain a foothold. This means that they are gradually crowding in on these rocky habitats marginal to the open glade or rock formation.

In the case of a limestone bluff, the succession starts similarly to that of the limestone glade from a xerosere stage and eventually reaches the climax associates of sugar maple-white oak. However, the succession in the former case is much more rapid, and differs somewhat from that of the limestone glade on account of the difference in gradient of the slope, which affects the drainage and moisture relationships markedly. In the beginning stages of a limestone bluff formation only a few herbs take hold in the crevices of the bluff. Common pioneer types are hydrangea (*Hydrangea arborescens*), columbine (*Aquilegia canadensis*), poison ivy (*Toxicodendron radicans*), bulblet bladder fern (*Cystopteris bulbifera*), cliffbrake fern (*Pellaea glabella* and *P. atropurpurea*), Virginia creeper (*Parthenocissus quinquefolia*), and alum root (*Heuchera puberula* and *H. americana* var. *hirsuticaulis*).

As more soil accumulates and rocks disintegrate, a few hardy trees and shrubs, such as red cedar, *Bumelia lanuginosa*, *Rhus trilobata* var. *serotina*, *Physocarpus opulifolius* var. *intermedius*, and others, gain a foothold and help break up the rock and aid in soil formation (figs. 28, 29, and 30). More rapid succession takes place as a talus slope is built up with consequent occupation by many species, such as leafcup (*Polymnia canadensis*) and bladdernut (*Staphylea*), which carry the succession rapidly forward eventually toward the climax associates.

Thus far the associations which have been discussed are those whose final stages at least have developed largely from neutral to calcareous soils. We come now to a discussion of associations whose development proceeds from an acid type of soil.

III. OAK-HICKORY ASSOCIATION

(*Quercus-Carya*)

The first of these associations to be described is the oak-hickory. This is the common and prevailing association over most of the Ozark ridges, uplands, and upper slopes of hills. It develops on the drier and more acid of the ridge tops and upper slopes (fig. 31) and is probably the most complex association found in the Ozark region.

Just as a sugar maple-white oak association originates from an open limestone glade, so the oak-hickory association takes its origin from a prairie association beginning on an acid substratum. Many parts of the plateau now covered with a dense stand of oak-hickory were, according to the early settlers and records of travelers and writers, originally a prairie. This again illustrates the natural tendency under a climatic mesophytic climax for an open barren or prairie habitat to end in a forested area. The upland prairie flora of much of the Ozarks overlies areas of acid soils produced by Roubidoux sandstone or residual chert. The prairie flora which covers an



FIG. 31. A typical Ozark landscape, showing the abundant coverage by the oak-hickory association on the ridge tops and plateaus. South of Harley, Barry County.

upland may also originate on a sandstone, chert, granitic, or porphyritic trachyte barren (fig. 32), of which there are many types scattered throughout the Ozarks.

(1) The first woody plants to invade this prairie flora are sassafras and winged sumac (fig. 33). Each forms local colonies and together they comprise the first developmental stage of the association, the sassafras-winged sumac (*Sassafras albidum* var. *molle*-*Rhus Copallina*) associates. Fragrant sumac (*Rhus aromatica*) also at times forms societies in this associates. Persimmon alone frequently initiates instead of sassafras and winged sumac. Grasses and sedges common at this stage are wild oats grass (*Danthonia spicata*), slender fescue (*Festuca octoflora*), *Cyperus filiculmis*, and *Panicum linearifolium*.

(2) With the next stage the development of the forest flora becomes conspicuous, for it is at this time that black jack oak and

post oak penetrate the area. Usually these two trees are already present in a forest area contiguous to the prairie and merely move into the open territory afforded them. Black jack oak usually penetrates the area first, followed by post oak, the two constituting the black jack-post oak (*Quercus marilandica*-*Quercus stellata*) associates. This associates may form a temporary climax or subclimax over certain areas, and is particularly well developed on broad, level expanses of plateau of the Ozark Dome, as is especially well displayed on the level uplands in parts of Dent, Crawford, Shannon, Texas, Phelps, and Howell counties. Incursion of these oaks into



FIG. 32. Porphyritic trachyte glade of Red Rock Mountain, near Irondale, Washington County, showing a type of habitat which may be invaded by a prairie flora eventually culminating in an oak-hickory climax.

prairie habitats may frequently be observed along level prairie areas such as railroad right-of-ways and natural grassy openings bordering woods (fig. 34). This pioneering tendency of these scrub oaks to penetrate the prairie habitats is shown by the black jack-post oak "flats," which, according to earlier records and reports made by travelers and settlers in the region, were originally level, open, treeless expanses. In this associates the grasses of the preceding associates continue to occur, while broom sedge (*Andropogon virginicus*) and several species of *Panicum* also are found.

(3) The next successional development occurs with the entrance of black oak (*Quercus velutina*) into the black jack-post oak associates. Along with black oak usually appears Ozark hickory¹ (*Carya Buckleyi*

¹ The name Ozark hickory is applied here to distinguish this characteristic small-fruited Ozark species from *Carya glabra* and *C. cordiformis*, both known as pignuts. Since it would be very misleading to speak of a third type of hickory in Missouri as "pignut," the name "Ozark hickory" is preferred.

var. *arkansana*) and the two form a black oak–Ozark hickory associates (fig. 35). Since black jack and post oaks are light-demanding types, they begin to lose ground with the incursion into their associates of black oak. Black oak grows so much faster and eventually taller than the black jack and post oak that in time the latter become shaded, and this marks the beginning of an end for them; in other words, the beginning of another stage of the succession.

This black jack–post oak associates is the first of a later oak–hickory climax to invade the bald knobs and limestone glades of



FIG. 33. *Rhus Copallina* invading prairie habitat, one mile from Riverview bluffs, Morgan County. This is the first woody stage in the development of the oak–hickory association.

southwestern Missouri. Post oak and black jack oak begin this succession associated with the Ozark hickory; then black oak and Ozark hickory enter. On the knobs in later stages of succession are white oak and black oak, with post oak and Ozark hickory. The herbaceous flora found in this stage consists principally of *Tephrosia virginiana*, *Schrankia Nuttallii*, *Antennaria plantaginifolia*, *Lespedeza procumbens*, *Aster patens*, *Ascyrum hypericoides* var. *multicaule*, *Desmodium rotundifolium*, *Panicum dichotomum*, *P. sphaerocarpon*, *P. lanuginosum* var. *fasciculatum*, *P. flexile*, and *Acacia angustissima* var. *hirta*.

Usually black oak is the first to enter the black jack–post oak associates, but the oak–hickory association is a most complex one, and several other dominants or consociations may enter the black jack–post oak associates.

(a) There may be, for example, an incursion of white oak, which becomes dominant and with the black oak forms a white oak–black

oak associates. Or scarlet oak in the eastern Ozarks, as far west as Indian Creek and tributaries in Douglas County, may be the dominant oak type to penetrate the black jack-post oak associates.

(b) There may be an associates of scarlet oak-black oak with the scarlet oak predominant, or an associates of scarlet oak-Ozark hickory in which black oak is present, or there may be various mixtures of dominants, such as scarlet oak-Ozark hickory with black oak-Ozark hickory, or scarlet oak-black oak and white oak mixed.

(c) Sometimes in some of the porphyritic or granitic or sandstone territory in the southeastern Ozarks, in parts of St. Francois, Madison, Iron, Reynolds, and Wayne counties, winged elm, succeeding the black jack-post oak stage, may dominate to form an associates of winged elm-Ozark hickory (*Ulmus alata*-*Carya Buckleyi* var. *arkansana*).



FIG. 34. Upland woods with dense, grassy cover near head of Mud Creek, twelve miles north of Poplar Bluff, Butler County. Illustrates encroachment of oaks into prairie habitat, and shows the dominance of the blue-stem grasses in protected and unburned areas of pine or pine-oak forests. The area illustrated was unburned for many years.

(d) Also, in some parts of the Ozarks, as for example in the Potosi Ranger District of the Clark National Forest Purchase Unit in Washington County, northern red oak may follow a black jack-post oak associates and become dominant, together with black oak forming a northern red oak-black oak associates.

(e) In parts of southern Missouri southern red oak (*Quercus falcata*) may become dominant where it occurs, and with scarlet and black oak form an associates following a black jack-post oak associates.

The dominant understory shrubs of these various mixed oak-hickory associates consist of low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*) (fig. 35), and high-bush huckleberry (*Vaccinium stamineum* and its var. *neglectum*). Low-bush huckleberry continues to dominate and exist throughout the Ozark region, but the high-bush



FIG. 35. An oak-hickory associates on a flat upland near Dillard, Crawford County. *Vaccinium vacillans* var. *crinitum* is the dominant understory in such associations.

huckleberry begins to disappear as the northern and western borders of the Missouri Ozarks are reached. Under a scarlet oak-black oak associates or scarlet oak-Ozark hickory associates deerberry or farkleberry (*Vaccinium arboreum* var. *glaucescens*) is dominant. It may be common also in other associates. While *Vaccinium vacillans* var. *crinitum* is usually the climax understory in an oak-hickory or pine-oak associates, it may not always be. Sometimes, as in northeastern Wright County near Beaver Creek, there is instead of *Vaccinium vacillans* var. *crinitum* a great variety of herbs of an acid

soil flora, such as species of *Desmodium* and *Lespedeza*, *Psoralea psoraloides* var. *eglandulosa*, *Aureolaria grandiflora* var. *cinerea*, *Hieracium Gronovii*, species of *Panicum*, *Galactia volubilis* var. *mississippiensis*, *Solidago radula*, and others. Other common dominants forming the ground cover are summer grape (*Vitis aestivalis*), New Jersey tea (*Ceanothus americanus*), and *Lespedeza procumbens*. Fragrant sumac (*Rhus aromatica*) and sassafras are commonly found in the oak-hickory association from the black jack-post oak stage on. Winged sumac (*Rhus Copallina*) also is common in the association.

Sometimes black jack oak is absent from an area, leaving black oak, white oak, post oak, Ozark hickory, and shagbark hickory as associates. Ozark hickory is commoner usually on ridges or plateau tops and on south- and west-facing slopes than it is on north- or east-facing ones.

On the so-called "post oak flats," post oak, white oak, and Ozark hickory may be the common species, with white oak dominating. In some associates scarlet oak may be the abundant tree while in others it may be black oak.

These associates of the upland and ridge tops in the Ozark all develop on acid substrata and the herbaceous ground cover is tolerant of acid soil. In order of abundance throughout all the associates, in addition to those already listed, they are: dittany (*Cunila origanoides*), oats grass (*Danthonia spicata*), pussy toes (*Antennaria plantaginifolia*), goat's rue (*Tephrosia virginiana*), *Lespedeza repens*, *Panicum lanuginosum* var. *fasciculatum*, *Lespedeza hirta*, *Panicum dichotomum*, *Carex hirsutella*, cinquefoil (*Potentilla simplex* var. *genuina*), tick trefoil (*Desmodium marilandicum* and *D. rotundifolium*), and *Carex artitecta*. Other common herbaceous plants are *Aster patens*, *A. turbinellus*, *A. anomalus*, *A. linariifolius*, *Solidago ulmifolia*, and *S. petiolaris* var. *Wardii*.

Leucobryum, *Catharinea*, *Polytrichum*, and *Dicranum* are usually the most abundant mosses in this oak-hickory association; while of grasses, oats grass (*Danthonia spicata*), species of *Panicum*, and occasionally blue-stem (*Andropogon scoparius* and *A. provincialis*) are most conspicuous.

IV. OAK-PINE ASSOCIATION

(*Quercus-Pinus echinata*)

The next association, the oak-pine, will require some prefacing. Weaver and Clements (*Plant ecology*) consider pine only as a fire subclimax of the deciduous forest. This will be more fully discussed later. Suffice it to state at this time that these studies reveal that

southern yellow pine (*Pinus echinata*) in the Ozark region has not developed as a fire subclimax, but has originated as a natural association which is usually mixed with various climax species of oak. This association consists of two associates: (1) a pure pine type with species of *Vaccinium* forming the understory, which may be called the pine-

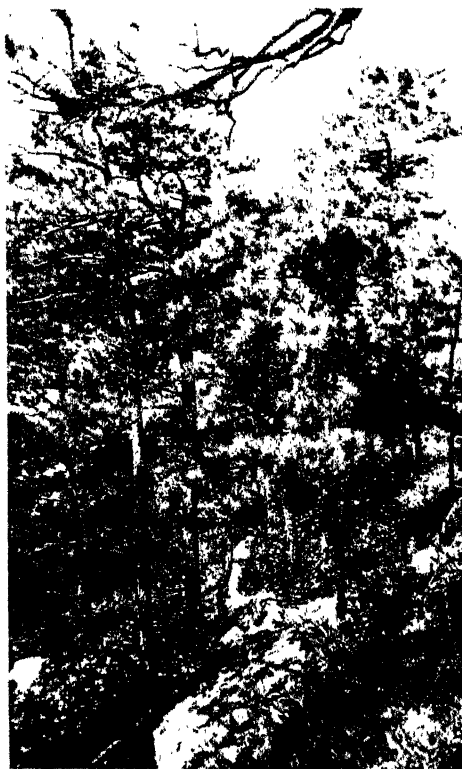


FIG. 36. *Pinus echinata* developed in almost pure stand on Pine Bluff, overlying Roubidoux sandstone along Meramec River, four miles south of St. Clair, Franklin County.

huckleberry (*Pinus echinata*-*Vaccinium*) associates, and (2) the mixed oak-pine (*Quercus*-*Pinus*) associates.

Pine occurs on acid soils associated with such rocks as sandstone, chert or flint, and granite or porphyritic trachyte, which yield acid soils. On such soils it is usually found on the upper slopes of hills, or on narrow ridges underlain by sandstone or chert. It is much commoner on the narrower ridges than on the broader, flat, undissected plateau portions; in other words, it is most dominant where the upland is most dissected and the drainage pattern best developed.

(1) Pure stands of pine are rare today and occur locally along the tops and upper slopes of the ridges and on bare sandstone or chert glades or outcrops (figs. 36 and 37). A pure pine associates may start wherever exposed acid rock or the like occurs. On such bare or exposed areas pine, free from any other woody species, pioneers by



FIG. 37. Pure pine stand on ridge top north of Bunker, Reynolds County. Note the sparse herbaceous undergrowth characteristic of the coverage under a pure pine grove.

seeding itself. This incursion by pine on open ledges and outcrops free from competitors results in a local pure stand. Species of blueberry, locally called huckleberry, low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*), *Vaccinium stamineum* and its var. *neglectum*, and farkleberry (*Vaccinium arboreum* var. *glaucescens*) comprise the climax understory in the pure pine associates. The herbaceous ground cover under pure pine is very sparse, consisting mostly of *Lespedeza procumbens* and *L. repens*, horsemint (*Monarda Bradburiana*), catgut (*Tephrosia virginiana*), dittany (*Cunila origanoides*), tick trefoil

(*Desmodium marilandicum* and *D. rotundifolium*), and pussy toes (*Antennaria plantaginifolia*). Species of *Panicum* (*P. linearifolium*, *P. dichotomum*, *P. commutatum* var. *Ashei*, and *P. lanuginosum* var. *fasciculatum*), slender fescue grass (*Festuca octoflora* var. *tenella*), oats grass (*Danthonia spicata*), species of *Carex* (*C. hirsutella* and *C. artitecta*), broom sedge (*Andropogon virginicus*), and blue-stem (*Andropogon scoparius* and *A. provincialis*), comprise the dominant grasses and sedges. Such pure stands of pine today occur around Pickle Creek and River Aux-Vases in Sainte Genevieve County, and in portions of the Piney and St. Francis River country. Extensive lumbering has diminished much of the pine stands, and pine forests were formerly much more numerous in many places than they are today.

(2) Much more common than the pure pine associates is the mixed oak-pine associates, which may have several variations. The associates may consist of (a) black jack and post oak with pine, or (b) black oak, mockernut hickory, and Ozark hickory with pine, or of (c) white, black, and scarlet oak, Ozark hickory and shagbark or mockernut hickory with pine. The last type is the commonest and climax stage, in which pine is associated with the dominant or climax species of the oak-hickory association. This last stage develops from the second, which in turn proceeds from the first stage of succession with the pine.

Variations in Stage No. 2:

(a) The first type, with black jack, post oak, and pine usually develops in an area where a pine stand is contiguous to a black jack-post oak woods. At the zone of contact between the two some of the black jack and post oak seed themselves in natural openings in the pine forest, and in time form a mixed forest with the pine. In other words, the oak has penetrated into the pine forest rather than vice versa. The black jack and post oak also may enter a pine stand when the latter is developed on bare sandstone or chert outcrops. Such exposures of acid rock or even shallow soil areas with acid rock near the surface may give a foothold here and there for pioneer black jack and post oak. Once these oaks take hold, they begin to increase in other openings and again the mixed type occurs.

(b) Pine grows faster and consequently taller than black jack and post oak and is never actually dominated or towered over by them. In time, however, black oak, together with the hickories mentioned in the second type, invades the black jack-post oak-pine associates, and enters into competition with the pine, finally suppress-

ing, by over-shading, the black jack and post oak. The oaks or hickories, while they do not succeed in overtopping the previously existing growth of pine with its more rapid rate of growth, may eliminate it by over-shading and crowding out the seedling pines.

(c) The third and climax stage of mixed oak and pine occurs after white and scarlet oak penetrate the last associates. This climax type is best developed on the narrow ridges and upper slopes of hills or heads of ravines and draws (fig. 15). A similar understory of species of *Vaccinium* dominates this associates; likewise, the herbaceous ground flora and grass associates is the same, with the exception that it is usually more luxuriant and of greater density than in a pure pine associates. The commonest mosses in this associates are *Leucobryum albidum*, *Catharinea*, *Dicranum scoparium*, *Polytrichum ohiense*, *Cirriphyllum Boscii*, and *Aulacomnium heterostichum*. Other shrubs besides *Vaccinium* in this associates are greenbrier (*Smilax glauca* var. *leuophylla*), smooth sumac (*Rhus glabra*), and winged sumac (*Rhus Copallina*). There is usually an abundance of broom sedge (*Andropogon virginicus*) and little blue-stem (*Andropogon scoparius*) in this stage.

The existence of pure pine stands of greater extent than those today will be discussed in a later portion of this paper.

V. WHITE OAK-RED MAPLE ASSOCIATION

(*Quercus alba*-*Acer rubrum*)

The last association to be discussed is that of white oak-red maple (*Quercus alba*-*Acer rubrum*). This would probably be united by Weaver and Clements with the oak-hickory association, but it always takes its origin from the same type of topographical expression and is so distinct that it seems a most natural one. This association commonly develops from drainages in acid soil areas, such as slight draws in ravines, heads of tributaries of streams, and upper slopes of hills and ravines. It may be initiated in the following manner: From the run-off following rains along the angle of dip of a slope, an otherwise level, broad plateau may develop a slight draw (or wash), which eventually serves as a path (or course) along and down which rainwater will trickle.

(1) This draw is occupied by the first stage, the flowering dogwood-sour gum (*Cornus florida*-*Nyssa sylvatica*) associates. These two trees pioneer with sassafras.

Sometimes on gravel washes which begin high or far up the ravines at the headwaters of a tributary, Ozark witch hazel (*Hama-*

melis vernalis) may be found, and in such places Ward's willow may also be present. The Ozark witch hazel occurs on draws which lead eventually into a stream or tributary of a stream, but is not found where an upland slope does not lead directly into a tributary.

On the gravel wash or cherty draw of the first stage of succession shrubby St. John's-wort (*Hypericum prolificum*) and hazel (*Corylus americana*) are often found.

(2) As the drainage head becomes more deeply dissected and a larger and deeper ravine develops, other species enter, and by this time red maple, which had previously made its appearance in the first associates, now becomes the dominant member, with mockernut hickory, to form the second stage of development, the red maple-mockernut hickory (*Acer rubrum*-*Carya tomentosa*) associates. In this associates smooth sumac (*Rhus glabra*), winged elm (*Ulmus alata*), and serviceberry (*Amelanchier canadensis*) are found together with the other woody species of the preceding associates. Pine may enter at this stage where footholds on open, rocky places occur. The pine in such places is scattered because of the discontinuous nature of the openings and the consequent more or less crowded conditions for entering the associates. As one approaches the northwestern limit of the Ozark region, red maple and sour gum, here at their northwestern distributional limits within Missouri, gradually become less conspicuous and drop out of the associates as important species, their places being taken more conspicuously by serviceberry, Ozark hickory, and flowering dogwood.

As the ravine is deepened and more soil accumulates, the forest becomes well mixed with other species and a number of oaks of sour soil types enter, such as white, scarlet, and black oaks. Northern red oak may occur; in this associates bitternut hickory often appears.

(3) Although the white oak had made its appearance at an earlier stage of succession, it now becomes the dominant species with red maple and forms the final stage, the white oak-red maple (*Quercus alba*-*Acer rubrum*) associates. Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*), farkleberry (*Vaccinium arboreum* var. *glaucescens*), and fragrant sumac (*Rhus aromatica*) comprise the main understory shrub layer, and in the southeastern Ozarks greenbrier (*Smilax glauca* var. *leurophylla*) should be included as a common member of the understory. The herbaceous ground cover consists of the usual thin, rocky, acid soil dominants of catgut, dittany, and some others, such as bracken fern (*Pteridium latiusculum*), *Lespedeza hirta*, and tick trefoil (*Desmodium marilandicum*

and *D. rotundifolium*), *Aureolaria grandiflora* var. *cinerea*, *A. pectinata*, *A. calycosa* (in the southeastern Ozarks), *Aster linariifolius*, *Solidago hispida*, and *Houstonia longifolia*. Other common species here are *Euphorbia corollata*, *Rosa carolina*, and *R. subserrulata*.

This ravine formation develops in acid soil areas and as the headwaters enlarge the valley and ravine, the floras of the lower slopes and valley penetrate the richer slopes and ravine bottom of

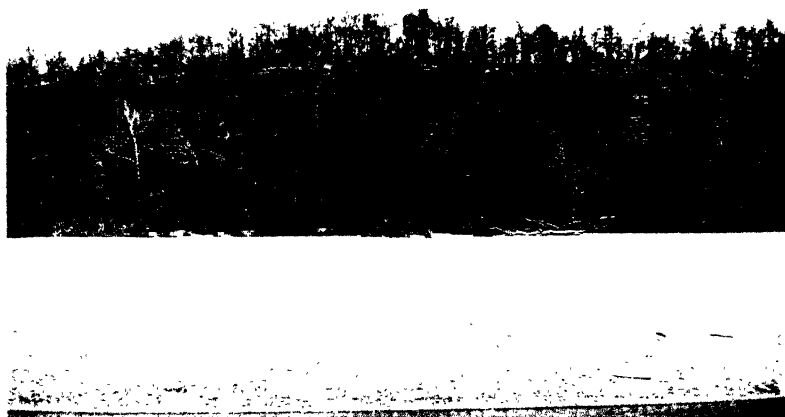


FIG. 38. South-facing limestone bluffs along White River opposite Table Rock, Taney County, showing how a vertical cross section of this locality would include all stages in the development of a flood-plain association, through the stages leading to the coverage of a limestone slope, and eventually, over a cherty substratum, to the stages leading to the oak-hickory climax.

the new drainage with such species as pawpaw, American hornbeam (*Carpinus caroliniana*), spicebush, redbud, chinquapin oak, butternut, shagbark hickory, and mulberry, while the flora of the ridge tops, plateaus, and upper slopes descends somewhat and overlaps that of the ravine and drainage types. Thus, the flora may become very diversified as the head of a ravine is followed down its course. Red maple, sour gum, white oak, and mockernut hickory comprise the tallest dominants, with flowering dogwood, sassafras, and serviceberry forming the conspicuous understory. One sees this association developed in all the ravines having acid soils and on all acid soil slopes along the dissected courses of streams.

These associations have been traced according to their origin and place of development. While they have been discussed in detail separately and disconnectedly, it should be emphasized that they

are all contiguous and overlapping. A good example of the close proximity of the associations is in connection with a limestone bluff along a river course. A vertical cross section of this bluff might reveal several stages in the development of the flood-plain flora following the river (fig. 38), leading to a limestone bluff with its various associates from a limestone glade or eroded escarpment to a climax or semiclimax stand of sugar maple-white oak; while directly overlying the limestone bluff formation might occur an eroded chert or sandstone ridge covered by red maple-white oak or pine-oak association,



FIG. 39. Right half of picture in background in white is covered by *Juniperus virginiana* overlying a limestone substratum; left half of picture mixed oak and pine overlying chert substratum. Shows how two totally unlike associations may develop side by side if growing on certain substrata. Along highway No. 19, two miles north of Eminence, Shannon County.

and on the broader plateau portion away from the hill slope might occur a climax oak-hickory association.

Also, as a result of variations in substratum even on one hillside and in the degree of erosion of the substrata, part of an association may be in some stage of development located amidst another association. This is a common occurrence on some limestone slopes where chert has been exposed along a draw or has been eroded from the surrounding limestone formation. This natural admixture of associations often results in a mixture of the understory. The effect of the substratum upon the plant association which develops on it is well shown where one part of a hillside which has a limestone substratum develops the calciphilous red cedar associates, while adjacent to the latter on a cherty soil is developed the oxylophilous southern yellow pine associates (figs. 39 and 40).

SUBCLIMAX STAGES IN THE OZARKS

Throughout the study of natural succession in the Ozarks, various subclimax stages were observed in the different associations.

(a) There are two subclimaxes possible in the successional stages over an eroded limestone substratum covered eventually by a sugar maple-white oak association: (1) a red cedar subclimax, and (2) a chinquapin oak subclimax. The former (*Juniperus virginiana*) type may persist as long as eroded limestone bluffs or glades remain. Red cedar is a pioneer and monopolizer of such limestone-barren areas. Ozark uplifts followed by erosion have been the natural means of preserving such areas, which have been constantly occupied and reoccupied by cedar. As long as a bare rocky limestone substratum occurs, cedar will be its dominant occupant. Dynamiting of limestone areas to open up new exposures of rock, or artificial prevention of soil cover over the limestone barren are methods by which the area could be enlarged, if desired. Also, cutting so that only cedar is left will again bring on a cedar associates, since, being a light-demanding species, it will pioneer on open places.

(b) Another subclimax, that of chinquapin oak (*Quercus Muhlenbergii*) is reached on south- and west-facing limestone slopes. As already explained, the covering up of a red cedar glade eventually leads to dominance of the chinquapin oak stage. This may eventually culminate in the climax sugar maple, but a subclimax of the chinquapin oak may be reached on south- and west-facing slopes. At least, on such slopes chinquapin oak can last indefinitely because the greater exposure and drouth, and the windswept nature of such slopes, tend to keep chinquapin oak dominant and at the same time prevent sugar maple from encroaching upon such dry exposures.

(c) Another subclimax is reached in the development of the flood-plain flora. As will be recalled from discussions above, the flora of the flood-plain areas culminates in a sugar maple-bitternut hickory climax associates. It is possible before this climax stage is reached for a subclimax of elm in the elm-ash associates to be developed. A subclimax of elm may continue as long as conditions are unfavorable for the entrance of sugar maple into the associates (example No. 161). This may occur in several ways. If, for example, a flood-plain flora is developing within a region surrounded by acid soils of sandstone or chert, and the acid soils prevent entrance of sugar maple upon the slopes underlain by such rock, the elm in the valley would reach its dominance and not become eventually dominated by sugar maple, as would be the case if it were in a region surrounded immedi-

ately by limestone substrata. Also, a subclimax of elm would be reached in a region outside the distributional limits of sugar maple. Besides, in a flood-plain region developed where there are no rock exposures, such as in a prairie area, or in a flood plain in a late stage of valley development where the flood plain is several miles wide bordered by low hills with few or no outcrops, the subclimax of elm may be attained.

(d) Just as a subclimax of red cedar may be reached on an eroded limestone slope, so may a subclimax of southern yellow pine be



FIG. 40. Right half of picture in background in white is covered by *Juniperus virginiana* overlying a limestone substratum; left half of picture mixed oak and pine overlying chert substratum. Shows how two totally unlike associations may develop side by side if growing on certain substrata. Along highway No. 19, two miles north of Eminence, Shannon County.

attained on an eroded sandstone or chert slope, ledge, or bare rock exposure. Pine is a pioneer on such rocky ledges and once it has gained a foothold on these areas, it monopolizes and takes possession of them. As long as pine has the open rock free from other woody species and undisturbed so that it can continue to invade and reseed on such areas, it will remain dominant and uncontaminated and so form a pine subclimax. In other words, as long as pine has penetrated the acid rocky area first, and the thin, acid soils continue as such, pine will form a dominance of a subclimax stage. This natural pioneering of pine on undisturbed, light, open territory is the basis for an understanding of the past history and the future of pine in the Ozark forests. In the past there were undoubtedly more stands of pine of larger and in many cases purer extent than there are today. This is borne out by logging records, by reports by early geologists

and scientific observers throughout the Ozarks, such as those of Shumard and Broadhead, and by reports of older settlers and "old-timers" within the region. Some of the records of pure pine stands from the latter sources were, no doubt, exaggerated, since early lumbermen and settlers frequently judged as pure a stand composed of 80-90 per cent pine, or, in other words, were "pine-minded" where the pine occurred in thicker and purer stands. According to some settlers, the entire country was covered with pine. When such reports are more critically traced to their sources, it is usually discovered that pine was found on the upper slopes and narrower ridges while the ravine bottoms and broader plateau expanses were occupied by oaks and hickories.

The natural pine succession in itself helps to explain the previous greater dominance and abundance of pine. As has already been explained, as soon as black jack and other oaks penetrate a pine stand, that purity of stand is gone forever, since the various hardwoods continue to compete and the pine is unable to suppress their continued development, with the result that a mixed oak-pine forest is developed. The demand by pine for light plus no competition explains the reason why pine in the Ozarks today will not reseed itself to a pure pine stand in an existent oak-pine forest. But pure pine stands may be seen today where pine is spreading into bare, sterile, or fallow fields overlying acid soil, or onto bare, acid rocks, or over thin, acid soils recently exposed by burns, road cuts, or dynamiting. Since it is well known, by records of scientific travelers throughout the Ozarks, and by reports of settlers and surveyors, that many portions of the upland Ozark plateau now forested were open prairie a hundred years or more ago, and since many such upland areas included open sandstone or chert ledges or outcrops, it is reasonable to believe that pine in pure and large stands pioneered and occupied such open areas. Present areas of similar nature support a dense pine growth and it seems likely that past areas would have had the same ecologic expression.

While pines existed in denser and purer stands many years ago, there were nevertheless upland forests of oak and mixed oak-pine. The records of earlier surveyors and scientific travelers not only record the "pineries" but also call attention to upland forests of oak and oak-hickory, alternating with pine. The oak and oak-hickory association always has been common in the Ozark region, but as a result of lumbering the pine forests, oaks and hickories have penetrated more into the areas occupied by the latter and have become even commoner than previously. This also is borne out by earlier

settlers' observations. In other words, oak becomes a real rival to the pine, and the latter can merely hold its own, and is unable to seed itself to advantage or gain dominance once it becomes mixed with oak and hickory. If most of the oaks and hickories are cut, pine has a clearing again of open and light, more or less undisturbed territory, and will seed itself in such situations. This condition may readily be seen today in driving over highways in the Ozarks where pine seedlings may be observed pioneering on the bare, open, acid soils along the road.

The facts that today on bare or open, acid, sandstone or chert ledges or acid soil prairies, the blue-stem grasses (*Andropogon scoparius* and *A. provincialis*) dominate, and that these same grasses appear commonly in protected or unburned areas in pine and pine-oak forests, seem to offer proof that pine enters such prairie grass areas and that under a condition of an open forest these same grasses continue to grow (fig. 34). Thus, the forest has occupied and is occupying the prairie, and the blue-stem and other prairie grasses now found in pine and pine-oak and other forest types merely remind us of the former existence of that area as a prairie, rather than as a forest type. In other words, the forest has gradually been encroaching upon the prairie rather than vice versa.

As one goes northward and northwestward along the border of the Ozarks, pine becomes less and less conspicuous, while oaks and hickories become commoner. The chances of the occurrence of pure pine stands diminish as one goes toward the boundary of the Ozark region, while the chances of the occurrence of mixed pine-oak and oak-hickory stands increase. Thus, around the Dillard camp area in the Clark National Forest Purchase Unit and in other places in that region pine is absent, being too near its northern limit or as far as its past geological migration has permitted it to go. However, post and black jack oak and Ozark hickory in that region are supported by an upland acid soil, and pine could easily be planted on such a soil and could become common, provided the necessary light, open, undisturbed conditions could be given. This would apply elsewhere on existent acid soil areas.

PLANT INDICATORS OF ACIDITY AND ALKALINITY

On account of the unglaciated condition of the Ozarks, with residual soils and rock outcrops everywhere, the relationship between the occurrence of a species and its underlying substratum is very obvious. It is true that other factors, such as the exposure

of the slope, i.e. whether north or south, or the proximity to water, or exposure to sunlight, play an important rôle in affecting distribution of the various species, but the factor of the soil acidity in relation to the rock from which the soil has been derived appears to be the most important one in determining distributions of many species. This is most apparent wherever the soil is thin and the rock substratum is near the surface or exposed as bluffs, ledges, and the like. So frequently is the same species found on particular soils of an acid or alkaline reaction, that many species are actually indicators of certain types of soils.

The acid soils of the Ozarks are derived from sandstone, cherts, and flints, or granitic rocks, while the alkaline types originate from limestones and dolomites. The ridge tops and upper slopes of many of the hills in the Ozarks are mostly acid in soil reaction because they are underlain by either sandstones or cherts. This is one reason why pine occurs largely on ridge tops and upper slopes. The limestones, on the other hand, are exposed mainly as bluffs and in outcrops along the streams and from the bases of hills to two-thirds or three-fourths the way up the slope, and these give rise to alkaline soils. Draws in the heads of ravines which usually originate in the upper cherty portions of the upland are generally of an acid nature. Plant species of alkaline soils are often found on neutral soils as well. The alluvial soils and those found in the development of the flood-plain flora are usually types about neutral in reaction and there no plant indicators are found on them. White oak is found on all types of soils, both acid and alkaline, dry and rocky as well as alluvial, and does not indicate any particular acidity type.

(a) The following species in the Ozarks are *plant indicators* of *acid* soils, and where limited to certain associates the name of that associates is given immediately after the scientific name:

- Agrostis (*Agrostis Elliottiana*)
- Aster (*Aster linariifolius*)
- Bastard toadflax (*Comandra Richardsiana*)
- Bedstraw (*Galium arkansanum*)
- Bedstraw (*Galium pilosum*)
- Black jack oak (*Quercus marilandica*)
- Black or sour gum (*Nyssa sylvatica*)
- Blue curls (*Trichostema dichotomum*)
- Blue-stem (*Andropogon scoparius* var. *genuinus*)
- Bluet (*Houstonia longifolia*)
- Bracken (*Pteridium latiusculum*)
- Broom sedge (*Andropogon Elliottii*)
- Broom sedge (*Andropogon virginicus* var. *genuinus*)
- Bulbostylis (*Bulbostylis capillaris*)
- Bush clover (*Lespedeza hirta*)

- Bush clover (*Lespedeza procumbens*)
- Bush clover (*Lespedeza repens*)
- Bush clover (*Lespedeza virginica*)
- Catgut, hoary pea (*Tephrosia virginiana*)
- Cinquefoil (*Potentilla canadensis* var. *villosissima*)
- Cinquefoil (*Potentilla simplex*)
- Crotonopsis (*Crotonopsis elliptica*)
- Dropseed (*Sporobolus vaginiflorus*)
- Early bunch grass (*Sphenopholis nitida*)
- Fall witch grass (*Leptoloma cognatum*)
- False dandelion (*Krigia Dandelion*)
- Farkleberry (*Vaccinium arboreum* and var. *glaucescens*)
- Goldenrod (*Solidago hispida*)
- Greenbrier (*Smilax glauca* var. *leurophylla*)
- Harvey's buttercup (*Ranunculus Harveyi*)
- Hedgehog club-rush (*Cyperus filiculmis*)
- Hedgehog club-rush (*Cyperus ovularis*)
- High-bush huckleberry (*Vaccinium stamineum* and var. *neglectum*)
- Indian grass (*Sorghastrum nutans*)
- Knotweed (*Polygonum tenue*)
- Ladies' tobacco (*Antennaria plantaginifolia*)
- Liverleaf (*Hepatica americana*)
- Low-bush huckleberry (*Vaccinium vacillans* and var. *crinitum*)
- Mockernut hickory (*Carya tomentosa*)
- Ozark hickory (*Carya Buckleyi* var. *arkansana*)
- Panic grass (*Panicum depauperatum*)
- Panic grass (*Panicum dichotomum*)
- Panic grass (*Panicum lanuginosum* var. *fasciculatum*)
- Panic grass (*Panicum linearifolium*)
- Panic grass (*Panicum perlongum*)
- Panic grass (*Panicum sphaerocarpon*)
- Paspalum (*Paspalum ciliatifolium* var. *Muhlenbergii*)
- Pencil flower (*Stylosanthes biflora*)
- Pine-weed (*Hypericum gentianoides*)
- Pinweed (*Lechea tenuifolia*)
- Pinweed (*Lechea villosa*)
- Post oak (*Quercus stellata*)
- Poverty grass (*Aristida dichotoma*)
- Red maple (*Acer rubrum*)
- Rough buttonweed (*Diodia teres*)
- Rush (*Juncus marginatus*)
- St. Andrew's cross (*Ascyrum hypericoides* var. *multicaule*)
- Scarlet oak (*Quercus coccinea*)
- Sedge (*Carex artilecta*)
- Sedge (*Carex hirsutella*)
- Sedge (*Carex umbellata*)
- Sensitive pea (*Cassia nictitans*)
- Serviceberry (*Amelanchier canadensis*)
- Slender fescue grass (*Festuca octoflora* var. *tenella*)
- Southern red oak (*Quercus falcata*)
- Southern yellow pine (*Pinus echinata*)
- Spiderwort (*Tradescantia longipes*)
- Star violet (*Houstonia pusilla*)
- Sundrops (*Oenothera linifolia*)
- Tick trefoil (*Desmodium laevigatum*)
- Tick trefoil (*Desmodium marilandicum*)

Tick trefoil (*Desmodium nudiflorum*)
 Tick trefoil (*Desmodium obtusum*)
 Tick trefoil (*Desmodium rotundifolium*)
 Triple-awned grass (*Aristida oligantha*)
 Turkey pea (*Clitoria mariana*)
 Violet (*Viola triloba* and var. *dilatata*)
 Wild honeysuckle, pink azalea (*Rhododendron nudiflorum* var. *roseum*)
 Wild oats grass (*Danthonia spicata*)
 Woodrush (*Luzula campestris* var. *bulbosa*)
 Yellow star grass (*Hypoxis hirsuta*)

(b) The following species in the Ozarks are *plant indicators* of *alkaline* soils, and where limited to certain associates, the name of that associate is given immediately after the scientific name:

Asclepiodora (*Asclepiodora viridis*); *Bouteloua-Rudbeckia* associates
 Bedstraw (*Galium virgatum*); cedar associates
 Blue ash (*Fraxinus quadrangulata*); chinquapin-ash associates
 Buckthorn (*Rhamnus lanceolata*)
 Calamint (*Satureja glabella* var. *angustifolia*); *Bouteloua-Rudbeckia* associates
 Chinquapin oak (*Quercus Muhlenbergii*); chinquapin-ash associates
 Chittim-wood (*Bumelia lanuginosa*)
 Cowbane (*Oxypolis rigidior*)
 Crosswort (*Lysimachia longifolia*)
 Early meadow rue (*Thalictrum dioicum*)
 Evolvulus (*Evolvulus Nuttallianus*); *Bouteloua-Rudbeckia* associates
 False aloe (*Agave virginica*); *Bouteloua-Rudbeckia* associates
 Wood's hellebore (*Veratrum Woodii*)
 False pennyroyal (*Isanthus brachiatus*)
 Feverfew (*Parthenium hispidum*); *Bouteloua-Rudbeckia* associates
 Goldenrod (*Solidago Drummondii*)
 Grass-of-parnassus (*Parnassia grandifolia*)
 Heliotropium (*Heliotropium tenellum*); cedar associates
 Houstonia (*Houstonia nigricans*); cedar associates
 Indian cherry (*Rhamnus caroliniana* var. *mollis*); cedar associates
 Kentucky blue grass (*Poa pratensis*)
 Leavenworthia uniflora; *Bouteloua-Rudbeckia* associates
 Liverleaf (*Hepatica acutiloba*)
 Melic grass (*Melica nitens*); cedar associates
 Missouri primrose (*Oenothera missouriensis*); cedar associates
 Mountain mint (*Pycnanthemum virginianum*)
 Prairie clover (*Petalostemum purpureum*); *Bouteloua-Rudbeckia* associates
 Red cedar (*Juniperus virginiana*)
 Rudbeckia (*Rudbeckia palustris*)
 Running strawberry-bush (*Euonymus obovatus*)
 Rush (*Juncus diffusissimus*)
 Sandwort (*Arenaria patula*); *Bouteloua-Rudbeckia* associates
 Satin grass (*Muhlenbergia sobolifera*)
 Schneck's red oak (*Quercus Shumardii* var. *Schneckii*); chinquapin-ash associates
 Scurfy pea (*Psoralea tenuiflora*); cedar associates
 Sedge (*Carex eburnea*)
 Sedge (*Carex leptalea*)
 Side-oats grama grass (*Bouteloua curtipendula*)
 Slippery elm (*Ulmus fulva*)
 Sugar maple (*Acer saccharum* var. *glaucum*)
 Tansy mustard (*Descurainia pinnata* var. *brachycarpa*)

Umbrella grass (*Fuirena simplex*)

Vervain (*Verbena simplex*); cedar associates

Whitlow Grass (*Draba cuneifolia*); *Bouteloua-Rudbeckia* associates

Widow's cross (*Sedum pulchellum*)

Wild columbine (*Aquilegia canadensis*); chinquapin-ash associates

Wild onion (*Allium stellatum*); cedar associates

Most of the acid soil indicators occur in woods of either red maple-white oak, oak-pine, or oak-hickory associates. Those most indicative of calcareous soils are found, especially in the first few stages, in the covering of the limestone glade, first the limestone glade, then the "cedar" stage, and finally on to the chinquapin oak and eventually sugar maple stage.

ECOLOGICAL VARIATIONS INDUCED BY BURNING, LOGGING, CLEARING, AND OTHER UNNATURAL CAUSES

The various units and their succession as above discussed represent the natural and typical manner in which the vegetation has developed. There have, however, been various factors at work, such as burning, overgrazing, logging, and erosion, which have often helped to change the natural aspect of the succession. The present picture, therefore, in places, represents a hodgepodge, because while the association is still recognizable as a unit, the component species of its various stages have been suppressed at one time or in one section while accelerated at another period or in some other portion. This has led to an unbalanced and often unnatural appearance of the association. The various factors which cause this variation also work unevenly. Burning alone may cause certain changes in the normal course and rate of development, while over-grazing or logging alone may effect still other changes. When, however, instead of one of these acting alone there is a combination of burning, logging, and over-grazing, the effect of an unequal rate of development of the various species may be visualized.

Burning.—Burning has very definite results on succession. In taking stock of burns both the forest cover and the herbaceous ground flora must be considered; too frequently only the effect on the former has been stressed. Spring burns do considerably less damage than summer burns, so far as the effect on the succession is concerned, as they only retard it or keep it at a standstill. The herbaceous ground flora does not suffer extensively from a spring burn; a few of the more tender species may perish here and there as a result of diminished humus cover, but in general the ground cover remains at a standstill from year to year (fig. 41). The effect of spring burns on the forest and understory is even less than that

on the herbaceous ground cover. The trees and shrubs after spring burns throw out new foliage; some become scorched here and there, but the killing effect is negligible. The quality of the timber does not suffer nearly as greatly from spring burns as from the scarred effects left on the wood by summer burns. Repeated annual spring burning for a few years merely destroys the yearly leaf litter, and thereby keeps the soil light and more or less open, preventing the accumulation of a dense leaf litter. This naturally allows those species which



FIG. 41. Effect of a spring burn, showing a very light density of forest floor coverage. Note the open patches of soil between the herbs. Twelve miles north of Poplar Bluff, T. 26 N., R. 7 E., sec. 20 and 21, Butler County.

favor light, open ground, relatively free from leaves, to become commoner and more or less dominant.¹

Gradually, however, annual spring burnings wear down the soil cover, and if continued over many years—perhaps 20 or 30—soil may be worn down to its underlying rock substratum, which in the

¹ At this point it may be stated that most of the burns observed occurred on acid soil substrata, either upland slopes, ridges, and broad plateaus, or ravines and draws in acid soil areas; therefore, in the oak-hickory, red maple-white oak, or oak-pine associations. No burns were observed within the limestone soil areas of the sugar maple-white oak association. This may be due to the fact that most of the limestone areas are in broken, rough country in the form of bluffs or glades, usually next to streams, a type of country seldom fired by the Ozark people, while the commonly fired hilltops and adjoining uplands and ravines have an underlying acid substratum of eroded chert, flint, or sandstone. Thus, there are perpetuated upon such places species found on light, open, acid soils, such as catgut (*Tephrosia virginiana*), dittany (*Cunila origanoides*), pussy toes (*Antennaria plantaginifolia*), horsemint (*Monarda Bradburiana*), bracken fern (*Pteridium latiusculum*), and various species of *Lespedeza* and tick trefoil (*Desmodium rotundifolium*, *D. Dillenii*, *D. marilandicum*, *D. obtusum*, and others), sensitive pea (*Cassia nictitans*), cinquefoil (*Potentilla simplex*), and oats grass (*Danthonia spicata*).

case of much of the Ozarks is Roubidoux sandstone or chert. Thus, in many parts of the Ozark region many flinty hills are so exposed that they resemble a barren rock pile. In such cases the soil is worthless and will support only a sparse cover, much more sparse than before, and this sparse cover is very often dominated by the worth-



FIG. 42. Damage done by summer burn, along highway No. 49, just south of Black, Reynolds County. The burn occurred on June 25 and the picture was taken August 14 of the same year. Note how the area was burned down to the chert substratum, and how the sumac (*Rhus Copallina*) has already sprouted at the bases of the stems.

less oats grass (*Danthonia spicata*). If practiced for many years, spring burning leads eventually to destruction of a soil cover and causes the herbaceous ground cover to revert to an earlier stage of succession.

The effect of a spring burn on the succession is rather slow compared with that of a summer burn. Summer burns cause serious scars on the bark which leave impressions in the wood, so that its

quality is injured. Summer burns do not kill the older trees but only the lower branches of some of the younger ones, but very often one-year-old to twenty-year-old saplings are killed. Saplings are killed from the tops to the base of the stem, and if they come back thereafter, it is from the sprouting of underground shoots (fig. 42).



FIG. 43. Same burn shown in Fig. 42. Note damage done to the herbaceous vegetation.

The understory succession may be set back from one to twenty years as a result of a summer burn. Usually a summer burn throws back the stage of succession only a few years.

The effect of a summer burn on the herbaceous ground cover is much more abrupt and deteriorating (fig. 43). The more tender herbaceous growth is killed outright and many species usually do not recover enough to come up again from sprouts. Thus many species are lost in that area for a while and may not return for many years, and in the case of some selective types, may never return. As a rule,

however, members of the Leguminosae, Compositae, Euphorbiaceae, and Gramineae survive summer burns sufficiently to come back from underground shoots. Species of *Lespedeza* and *Desmodium*, catgut (*Tephrosia*), *Rosa*, *Antennaria*, *Panicum*, *Danthonia*, *Carex*, winged and smooth sumacs (*Rhus Copallina* and *R. glabra*), flowering spurge (*Euphorbia corollata*), and a few others come up again after summer burns. The succession of the herbaceous ground cover is, however, set back several years, because summer burns wear the soil away to the rocky substratum stage so much sooner (fig. 42), and the more this condition is approached, the more rapidly the earlier stages of ground vegetation are reached.

These spring and summer burns do not at the time of their occurrence destroy all the herbaceous ground cover of an area. Most of it is taken, but patches here and there are left untouched, and species from these unburned patches have the advantage of reproducing their kind over the barren area without much interference, so that certain species sooner or later may dominate the burned areas. Summer burns may be said to wear down the soil cover more rapidly than spring burns and throw back the succession more quickly to an earlier stage of development.

Burning in general has a deteriorating effect by diminishing most of the palatable forage grasses, and this is an important issue in the entire question of burns. The grass that used to be the commonest and best range grass in the Ozarks was blue-stem (*Andropogon scoparius* mostly, with some *A. provincialis*). This covered large tracts in open oak-hickory and oak-pine woodlands and occurred in great density. Blue-stem and broom sedge (*Andropogon virginicus*), species of *Panicum*, *Sorghastrum nutans*, and species of *Carex* (*C. artitecta*, *C. hirsutella*, and others), were common. Wild oats grass (*Danthonia spicata*) was much less common then than today, because the other grasses prevented its development. As fires increased and annual burning became commoner with increased settlement, the density of the important grasses became less and less. Finally, in many places the stage was reached where bare, open places existed, and became commoner as grass and other herbage grew less dense. This type of light, open, rocky soil habitat became the territory which wild oats grass (*Danthonia spicata*) most favored. It increased in such open, rocky areas and in time became dominant, until now it is the commonest grass of the upland acid slopes and ridges. It is not a good forage grass, and its establishment on light, open, rocky soil areas caused by burning indicates the harm caused by repeated and un-

controlled burning. If the people in the Ozarks burn their forests to get a cover of more grass for forage, they are being deceived into believing that oats grass is good, while as a matter of fact it is inferior.

The rate of deterioration or reversion to an earlier and earlier stage of the ground cover is directly influenced by the slope gradient. In



FIG. 44. Flat ridge top in *Quercus alba*-*Quercus stellata* woodland, four miles northwest of Bunker, Reynolds County. Note thick leaf covering with resultant scarcity of undergrowth.

the case of a steep slope, the soil is worn down much more rapidly to flint or sandstone than in that of the flat upland ridge or plateau. With the latter a very much longer period of time is required to wear the ground down to a rock substratum.

Shading and the density of leaf litter on the ground have definite effects on the herbaceous ground flora. For the most part, shading and a dense ground cover produce a sparse ground flora, and a sparse

grass flora in particular. The following conditions serve to show the various types found within the Ozarks:

(1) If the soil has been worn down as a result of *continued fires* to the *flinty* or *sandstone substratum*, and at the same time the *woods* are *more* or *less* open, the herbaceous cover is poor and the inferior oats grass (*Danthonia spicata*) is dominant among the grasses present.

(2) If the soil as a result of *scattered burns* has been worn down so that it is still *intact* but also *rocky* and at the same time the woods



FIG. 45. *Quercus alba*-*Quercus velutina*-*Quercus stellata* woodland on flat ridge top, four miles northwest of Bunker, Reynolds County, near ridge top shown in Fig. 44. Note the dense sprout undergrowth, but poor herbaceous ground flora.

are more or less open, the result is usually a rich and dense herbaceous vegetation with grasses and legumes dominating, and usually the better forage grasses, such as blue-stem (*Andropogon scoparius* and *A. provincialis*) and panic grasses, predominate, while oats grass is inconspicuous. This is a desirable condition.

(3) If the soil on a flat upland *ridge* or *plateau* is *built up* and covered by a *dense forest* of younger trees, the effect of shade and at the same time a dense leaf litter, is such as to produce a very sparse ground flora, the grasses being almost negligible (fig. 44).

(4) If a forest such as is found in the preceding type, with *built-up soil*, is *burned over* and a *dense stump sprout* growth springs up, the sprouts act as wind-breaks and allow dense coverings of leaves to accumulate in their vicinity. Wherever these dense leaf piles appear, the grasses are absent, especially oats grass. Some legumes, such as *Lespedeza procumbens*, may be present, but the flora as a whole is

sparse. Only in light and rocky openings, between leaf piles or where rock is exposed, or around the bases of trees, does the ground flora become denser.

(5) In areas *protected from burns* and at the same time with an *open woodland*, a variety of grasses return and in time approach their original dense growth.

(6) In areas protected from burns but with a *dense, crowded woodland*, the shade and leaf litter are too great for a rich ground flora, and consequently the herbaceous flora is very poor, especially in grasses (fig. 45). The ground cover may then be dominated by the shade-enduring low-bush huckleberry (fig. 35).

It appears that the densest growth of grasses of the better forage type is found in *open woods* protected from fire with a light, semi-rocky soil not extensively covered with leaf litter. If an area is repeatedly burned down, eventually to a rock substratum, oats grass becomes the most conspicuous grass.

A light, open, rocky soil also harbors a rich variety of legumes, many of which favor such a rocky, thin, open substratum. Thus, after continued burning with reduction of soil, such species increase in numbers because of an increase in their habitats. It is therefore incorrect to speak of such species as indicators of burning; rather they are species which appear in areas opened up by burning. The various herbs which are characteristic or commonest in areas opened by burns, or which tolerate burns, are the following:

Bracken fern (*Pteridium latiusculum*)

Bush clover (various species) (*Lespedeza procumbens*, *L. repens*, *L. hirta*, and *L. virginica*)

Catgut (*Tephrosia virginiana*)

Cinquefoil (*Potentilla simplex* var. *typica*)

Dittany (*Cunila origanoides*)

Fleabane (*Erigeron ramosus*)

Flowering spurge (*Euphorbia corollata*)

Forked chickweed (*Paronychia fastigiata*)

Greenbrier (*Smilax glauca* var. *leurophylla*)

Horsemint (*Monarda Bradburiana*)

Ironwood (*Vernonia Baldwini*)

Japanese clover (*Lespedeza striata*)

Pencil flower (*Stylosanthes biflora*)

Pennyroyal (*Hedeoma pulegioides*)

Pinweed (*Lechea tenuifolia*)

Pussy toes (*Antennaria plantaginifolia*)

Rose (*Rosa subserulata*)

Sensitive pea (*Cassia nictitans*)

Sweet everlasting (*Gnaphalium obtusifolium*)

Tick trefoil (various species) (*Desmodium rotundifolium*, *D. obtusum*, and *D. Dillenii*)

Wild indigo (*Baptisia leucantha* and *B. leucophaea*)

It will be seen that a great majority of these species belong to the pea and composite families. Catgut, dittany, greenbrier, *Lespedeza procumbens*, and *Desmodium rotundifolium* are especially common.

The grasses which are commonest in such burned areas are the following:

Oats grass

Species of *Panicum* (*P. dichotomum* and *P. lanuginosum* var. *fasciculatum*)

Hair grass (*Agrostis scabra*)

Sedge (*Carex hirsutella*)

In woods which have been burned over and opened up, winged sumac (*Rhus Copallina*) and sassafras are the commonest woody plants to enter and consequently are indicators of burning in that sense.

If, as these studies indicate, a great variety and density of leguminous species appear on light, thin soils of the rocky, open type—the type most directly produced by burning, especially summer burns—it might be advantageous on turkey ranges or other similar areas where leguminous foods are of high value, to burn, under controlled management, every five to ten years in order to revert the herbaceous ground cover to an earlier stage of succession where the leguminous flora will be at its maximum development. If this is not done, the natural succession of the ground flora, where fires are eliminated and where leaves consequently would accumulate and shade increase, would be towards a suppression of grasses and legumes, resulting in less abundance of turkey food.

Logging.—The effects of burning are thus found to be varying in degree and must be considered from different angles. The effects of logging on the natural succession of a forest are equally interesting. When tall trees are removed from a forest, the result is an open, sunny place where previously more or less shaded conditions existed. This creates a habitat within the forest equivalent to a prairie opening, and allows species which favor open and sun-lit conditions to enter, penetrate, or spread. Very often some species which come in on repeatedly cleared areas are the same as appear in burned-over areas, because similar habitats are created by burning and repeated clearing. In the case of a minor amount of cutting in a forest, done only rarely, the migration into that area of light-demanding species is not great. However, where repeated clearing continues, a number of species are commonly found which are more or less characteristic of open areas. The herbaceous species which may be called indicators

of repeated clearing, although they are merely species coming in on light, open soils, are the following:

Bitterweed (*Helenium tenuifolium*)
Black-eyed Susan (*Rudbeckia hirta*)
Bracken fern (*Pteridium latiusculum*)
Broom sedge (*Andropogon virginicus*)
Bush clover (*Lespedeza virginica*)
Buttonweed (*Diodia teres*)
Dewberry (*Rubus flagellaris*)
Everlasting (*Gnaphalium purpureum*)
Field sorrel (*Rumex Acetosella*)
Fleabane (*Erigeron ramosus*)
Flowering spurge (*Euphorbia corollata*)
Forked chickweed (*Paronychia fastigiata*)
Greenbrier (*Smilax glauca* var. *leurophylla*)
Ironweed (*Vernonia Baldwini*)
Japanese clover (*Lespedeza striata*)
Mullein (*Verbascum Thapsus*)
Pennyroyal (*Hedeoma pulegioides* and *H. hispida*)
Pinweed (*Lechea tenuifolia*)
Pussy toes (*Antennaria plantaginifolia*)
Thistle (*Cirsium lanceolatum*)
Wild indigo (*Baptisia leucantha* and *B. leucophaea*)
Wild petunia (*Ruellia caroliniensis*)
Yarrow (*Achillea Millefolium*)
Yellow hop clover (*Trifolium procumbens*)

The commonest species which appear on such areas are bitterweed, yarrow, greenbrier, and flowering spurge. Oats grass is by far the commonest of the grasses. Among the commonest shrubs are smooth sumac (*Rhus glabra*) and winged sumac (*Rhus Copallina*). Sassafras, persimmon, post and black jack oak, and winged elm are the only trees which are commonly found in or come into repeatedly cleared areas. The first woody species to spread into an opening in a forest induced by repeated clearing or logging are the smooth and winged sumac and sassafras. The natural home for these species is open prairie, borders of woods, or openings in woods. Thus, when conditions are created within a forest by clearing which establish an open habitat, these shrubs and trees are first to pioneer in response to their light-demanding requirements.

Repeated Clearing and Logging.—The effects of repeated clearing and logging are not as harmful as repeated burning. Logging and clearing merely open up the soil cover and understory, but do not materially disturb the understory or reduce the soil cover to the bare substratum as does repeated burning. If grasses of the better forage type are already present in sufficient numbers when the clearing occurs, they are thereby benefited, because new open places and an increase of favorable habitats are created. Thus, under such con-

ditions, grasses will increase in density, as will also legumes and composites and other light-demanding herbs. If, however, the soil has been worn down badly as a result of repeated burns, and the area is simultaneously or subsequently cut over, the worthless oats grass (*Danthonia spicata*) becomes more plentiful. In many instances it was observed that grasses were most plentiful and in greatest density in areas which had been opened up by logging but protected from fires. Thus, for best grazing ranges, it might be advantageous to cut over in part and at different times an area already covered with good forage grasses, so as to create more openings and sun-lit areas to be occupied by an increasing number of grass species.

Repeated clearing and logging result in such a mixture and confusion in the natural forest succession that it is at times difficult to interpret the stage at which it has arrived in a given forest. Therefore certain species are thinned out, and instead of the succession carrying on toward the climax stage, the earlier species of the succession may become once more dominant, and the previous dominant species may become temporarily suppressed. Thus, a temporary standstill or reversion may occur. In time, however, the species originally dominant usually persist and, if left to grow again from saplings or sprouts, finally enter the climax stages of the association.

Over-Grazing.—Many portions of the Ozark region are over-grazed. These areas usually occur on the upland. Usually a greater number of animals is turned loose over an area than can be supported on that area. The average density of the herbaceous ground cover varies according to different influences. The density of an herbaceous cover under a dense, unburned post oak-black jack oak stand is always very poor; that under an unburned, open, oak-hickory or pine-oak association is usually better; that of a logged but unburned area is usually good; that under an annually burned-over, open woods is usually quite poor, as is also one under a very much cut-over and burned-over woods. Since the normal density is not great, and does not average very much in an ordinary open oak-hickory or pine-oak forest, it is easy to allow too many animals to graze in such an area. When, in addition, open range hogs are turned loose to grub roots and eat herbage and nuts of various kinds indiscriminately, their effect on making a low density even lower should be emphasized. There is too much grazing on a limited amount of land in the Ozarks already. When it is considered that excessive over-burning in cut-over or non-cut-over areas lowers the ordinary density of herbaceous growth within a forest, and when to this is added the burden of over-

grazing, it is evident that the already sore conditions may be further aggravated. The Ozarks, if properly protected from fire and too much grazing, may afford valuable pasturage, a high density yield being possible in an open oak-hickory or oak-pine association. If too frequent burning and over-grazing are permitted, the low density at present encountered may be expected to continue. And in many areas in the Ozarks grazing in the uplands and slopes is not now practicable on a large scale.

When an upland area that has been cleared or cut over is then grazed, the constant cropping of herbage by too many cattle during summer leads to deterioration of the herbaceous cover, which in time becomes thinned out, exposing numerous bare patches of ground. When this condition has been reached, various species, mostly weedy and colonizing types, take possession. These are indicators of over-grazing, and may be the same as those on a sterile or fallow field.

The herbs which indicate over-grazing, because they are the ones which remain in a grazed-over area after the more delicate species have been eaten or have perished, are:

Bitterweed (*Helenium tenuifolium*)
 Blue vervain (*Verbena stricta*)
 Bracted plantain (*Plantago aristata*)
 Dwarf fleabane (*Erigeron divaricatus*)
 English plantain (*Plantago lanceolata*)
 Everlasting (*Gnaphalium purpureum*)
 Field sorrel (*Rumex Acetosella*)
 Hairy pennyroyal (*Hedeoma hispida*)
 Hogwort (*Croton monanthogynus*)
 Horse nettle (*Solanum carolinense*)
 Japanese clover (*Lespedeza striata*)
 Lesser ragweed (*Ambrosia bidentata*)
 Mullein (*Verbascum Thapsus*)
 Pinweed (*Lechea tenuifolia*)
 Plantain (*Plantago elongata*)
 Rough buttonwood (*Diodia teres*)
 Rush (*Juncus macer*)
 Sundrops (*Oenothera linifolia*)
 Sweet everlasting (*Gnaphalium obtusifolium*)
 Thistle (*Cirsium lanceolatum*)
 White boneset (*Eupatorium serotinum*)
 Yarrow (*Achillea Millefolium*)
 Yellow hop clover (*Trifolium procumbens*)

The following grasses are characteristic indicators of over-grazing:

Crab grass (*Digitaria sanguinalis*)
 Elliott's hair grass (*Agrostis Elliottiana*)
 Fescue grass (*Festuca octoflora* and var. *tenella*)
 Hair grass (*Agrostis scabra*)
 Poverty grass (*Aristida dichotoma*)
Sporobolus vaginiflorus
 Triple awn grass (*Aristida oligantha*)

Winged sumac (*Rhus Copallina*), sassafras, and winged elm are woody species that indicate over-grazing. These species all enter areas which have been over-grazed.

Interestingly enough, most of these species occur also on open, rocky, sandstone or chert or granite glades. In other words, the same conditions of thin, bare, worn-down, or acid soils prevail on both barrens of acid rock and on over-grazed fields. An over-grazed soil usually becomes worn down to the extent that bare patches of soil exist with stunted herbage; this type of condition approaches a glade in its sterile, open, dry, wind-swept soil, and thus, species favoring such areas pioneer quickly on such types.

Other Unnatural Conditions.—During dry summers in the Ozarks, cattle were observed to have an injurious effect on the vegetation of natural sink-hole ponds. Within certain parts of the eastern Ozarks, particularly in Reynolds, Shannon, Oregon, Texas, and Howell counties, are many such ponds. During ordinary seasons they usually remain filled with water. Most of those that dried up during the summer might have retained water had it not been for the cattle, which were allowed to wade in and out at any time; every time they emerged they took away water. Ordinarily evaporation during a summer merely reduces the water level, but does not dry up the pond. However, cattle shuffling in and out of the ponds caused many of the ponds to dry up completely. As the ponds become dried, the plants existing on the tussocks of sedges or in the lower crotches of shrubs are killed, both by lack of water and by being eaten by the cattle. Many of these plants at ordinary times furnish excellent forage, but when over-grazed and eaten to the roots by cattle, they are badly injured or killed. Since in these ponds many rare species of plants exist which are found nowhere else in the state, some way should be devised to prevent cattle from ruining the plants that serve as food for turkey, quail, duck, and other upland game life of the region.

The natural succession here is a series of stages eventually leading to a filling up of the pond and the establishment of a mesophytic forest thereon, and since such destructive over-grazing and drying up of these ponds by mismanagement of cattle grazing on them hastens their extinction, it seems highly important that steps be taken to protect ponds. Such ponds are valuable water reservoirs for game in the national forests, and every effort should be taken to keep cattle from destructive "stamping" in and out of the water from the pond.

Each of the following localities visited by the writer illustrates some special stage of development of a plant association discussed in the present paper. Usually the most conspicuous members of the plant association are listed under dominant trees or shrubs, and dominant herbaceous plants, as well as sub-dominants wherever it has seemed pertinent. The species listed as dominant are the most numerous in a given area.

Herbarium specimens of all the examples of plant associational cross sections in the following pages are to be found in the Herbarium of the Missouri Botanical Garden and the Herbarium of Field Museum of Natural History.

I. ACER SACCHARUM—CARYA CORDIFORMIS ASSOCIATION

(1) *Salix longipes* var. *Wardii*—*Hamamelis vernalis* Associes

1. Gravel bar at Hall's Bluff, south of Davidson's Blue Spring along Black River, sec. 4, T. 27 N., R. 4 E., four miles southeast of Mill Spring, Wayne County.

Dominant Trees

Ward's willow (*Salix longipes* var. *Wardii*) Sycamore (*Platanus occidentalis*)

2. Porphyritic stream bed in "shut-in" along Telleck Branch, sec. 23, T. 35 N., R. 1 E., three and one-half miles northwest of Shepherd, Iron County.

Dominant Tree

Sycamore (*Platanus occidentalis*)

Dominant Shrubs

Ward's willow (*Salix longipes* var. *Wardii*) Ozark witch hazel (*Hamamelis vernalis*)
Smooth alder (*Alnus rugosa*)

Associate

Sand grape (*Vitis rupestris*)

3. Gravel bar along Big Piney River between Dial's Camp, east of Big Piney and Ormsby's Place at Spring Creek crossing, T. 34–35 N., R. 10–11 W., Pulaski County.

Dominant Woody Plant

Ward's willow (*Salix longipes* var. *Wardii*)

Dominant Herbaceous Non-Grass Plants

Water willow (*Dianthera americana*) Chairmaker's rush (*Scirpus americana*)

4. Rocky stream bed along Noblett Creek, sec. 19, T. 26 N., R. 10 W., eight miles west of Burnham, Howell County.

Dominant Shrubs

Ward's willow (*Salix longipes* var. *Wardii*) Swamp dogwood (*Cornus obliqua*)
 Smooth alder (*Alnus rugosa*) Ozark witch hazel (*Hamamelis vernalis*)

5. Gravelly part of Piney Creek, sec. 19, T. 23 N., R. 24 W., five miles southwest of Cape Fair, Stone County.

Dominant Shrubs

Ozark witch hazel (*Hamamelis vernalis*) Possum haw (*Ilex decidua*)

Other Shrub Associates

Hop hornbeam (*Ostrya virginiana*) Swamp dogwood (*Cornus obliqua*)
 Rough-leaved dogwood (*Cornus asperifolia*) Ninebark (*Physocarpus opulifolius* var. *intermedius*)

6. Gravel bar along Pomme de Terre River, three miles northeast of Elkland, Hickory County.

Dominant Shrub

Ward's willow (*Salix longipes* var. *Wardii*)

Dominant Herbaceous Non-Grass Plant

Water willow (*Dianthera americana*)

7. Gravel bar along Osage River, sec. 2, T. 40 N., R. 13 W., west of Capps, Miller County.

Foxtail grass (*Setaria lutescens*) Lady's thumb (*Polygonum pennsylvanicum*)
 Panic grass (*Panicum virgatum*)
 Witch grass (*Panicum capillare*) Spurge (*Euphorbia supina*)
 Spurge (*Euphorbia serpens*)

8. Dry gravel bar along headwaters of Meramec River, sec. 14, T. 33 N., R. 4 W., two miles southeast of Max, Dent County.

Dominant Shrubs

Swamp dogwood (*Cornus obliqua*) Shrubby St. John's-wort (*Hypericum prolificum*)
 Ninebark (*Physocarpus opulifolius* var. *intermedius*) Sassaparilla (*Sassafras albidum*)
 Sand grape (*Vitis rupestris*)

Dominant Herbaceous Non-Grass Plants

Flowering spurge (*Euphorbia corollata*) Bush clover (*Lespedeza virginica*)
 Tick trefoil (*Desmodium sessilifolium*) Bush clover (*Lespedeza capitata*)
 Star tickseed (*Coreopsis pubescens*)

Dominant Grass

Panic grass (*Panicum virgatum*)

9. Gravel bar along Salt River, at Asher Ford, south of Spalding, Ralls County.

Dominant Woody Plants

Ward's willow (*Salix longipes* var. *Wardii*) Sycamore (*Platanus occidentalis*)

Dominant Herbaceous Non-Grass PlantWater willow (*Dianthera americana*)**Other Herbaceous Non-Grass Plant Associates**

Small white morning glory (<i>Ipomoea lacunosa</i>)	Wild bean (<i>Strophostyles helvola</i>)
Lady's thumb (<i>Polygonum lapathifolium</i>)	Water hemp (<i>Acnida tamariscina</i>)
Lady's thumb (<i>Polygonum pensylvanicum</i>)	Mule tail (<i>Erigeron canadensis</i>)
Smartweed (<i>Polygonum punctatum</i>)	Carpet weed (<i>Mollugo verticillata</i>)
Smartweed (<i>Polygonum Hydropiper</i> var. <i>projectum</i>)	Nodding spurge (<i>Euphorbia maculata</i>)
	Sida (<i>Sida spinosa</i>)
	Small ragweed (<i>Ambrosia artemisiifolia</i> var. <i>elatio</i>)

Dominant Grasses

Panic grass (<i>Panicum virgatum</i>)	Big blue-stem (<i>Andropogon provincialis</i>)
Slough grass (<i>Spartina pectinata</i>)	

Other Grass Associates

Panic grass (<i>Panicum dichotomiflorum</i>)	Crab grass (<i>Digitaria sanguinalis</i>)
Love grass (<i>Eragrostis cilianensis</i>)	

10. Gravel bed of Little Fourche à Renault Creek, sec. 2, T. 37 N., R. 1 E., two miles southeast of Floyd, Washington County.

Dominant Trees

Sycamore (<i>Platanus occidentalis</i>)	Persimmon (<i>Diospyros virginiana</i>)
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Dominant Understory

Swamp dogwood (<i>Cornus obliqua</i>)	Buck brush (<i>Symphoricarpos orbiculatus</i>)
Ward's willow (<i>Salix longipes</i> var. <i>Wardii</i>)	Shrubby St. John's-wort (<i>Hypericum prolificum</i>)
Sand grape (<i>Vitis rupestris</i>)	Rough-leaved dogwood (<i>Cornus asperifolia</i>)
Ninebark (<i>Physocarpus opulifolius</i> var. <i>intermedius</i>)	Black haw (<i>Viburnum rufidulum</i>)

(2) Acer saccharinum-Populus deltoides Associates

11. Alluvial banks along Black River between Mill Spring and Williamsville, sec. 30, T. 27 N., R. 5 E., Wayne County.

Dominant Trees

Cottonwood (<i>Populus deltoides</i>)	Sycamore (<i>Platanus occidentalis</i>)
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Dominant Understory

Ward's willow (<i>Salix longipes</i> var. <i>Wardii</i>)	Black willow (<i>Salix nigra</i>)
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12. Gravel bar at base of limestone slopes along Brushy Creek, sec. 8, T. 27 N., R. 3 E., six miles north of Ellsinore, Carter County.

Dominant Trees

River birch (<i>Betula nigra</i>)	Sycamore (<i>Platanus occidentalis</i>)
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Dominant Shrubs

Ozark witch hazel (<i>Hamamelis vernalis</i>)	Button-bush (<i>Cephalanthus occidentalis</i>)
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13. Sandy mud along Big Piney River, between Dial's Camp, east of Big Piney and Ormsby's Place at Spring Creek crossing, T. 34-35 N., R. 10-11 W., Pulaski County.

Dominant Woody Plants

Sandbar willow (*Salix interior*) Black willow (*Salix nigra*)

Dominant Herbaceous Non-Grass Plants

Blue mist flower (*Eupatorium coelestinum*) Cocklebur (*Xanthium pensylvanicum*)
 Lady's thumb (*Polygonum pensylvanicum*)
 Cardinal flower (*Lobelia cardinalis*)
 Beggar-ticks (*Bidens polylepis*)

Other Herbaceous Non-Grass Plant Associates

Broad-leaved arrow-head (*Sagittaria latifolia*) Smartweed (*Polygonum punctatum*)
 Hibiscus (*Hibiscus lasiocarpus*)

Dominant Grasses

Barngrass (*Echinochloa pungens*) Rice cut grass (*Leersia oryzoides*)

Other Grass Associates

Panic grass (*Panicum dichotomiflorum*) Panic grass (*Panicum Galtteri*)
 Witch grass (*Panicum capillare*)

14. Alluvial woods along lower part of spring branch of Onandago Spring, Crawford County.

Dominant Trees

Silver maple (*Acer saccharinum*) Black willow (*Salix nigra*)

Other Tree Associates

Sycamore (*Platanus occidentalis*) Box elder (*Acer Negundo*)
 River birch (*Betula nigra*) Honey locust (*Gleditsia triacanthos*)
 Bur oak (*Quercus macrocarpa*) American elm (*Ulmus americana*)

Dominant Understory

Elder (*Sambucus canadensis*)

Dominant Herbaceous Non-Grass Plants

Wild goldenglow (*Rudbeckia laciniata*) Aster (*Aster lateriflorus* var. *pendulus*)

15. Alluvial bottoms at Hall's Bluff, south of Davidson's Blue Spring, along Black River, sec. 4, T. 27 N., R. 4 E., four miles southeast of Mill Spring, Wayne County.

Dominant Trees

Silver maple (*Acer saccharinum*) Green ash (*Fraxinus pensylvanica* var. *lanceolata*)
 River birch (*Betula nigra*) Black willow (*Salix nigra*)
 Cottonwood (*Populus deltoides*)

Dominant Understory

Button-bush (*Cephalanthus occidentalis*)

16. Alluvial woods along lower part of spring branch of Schlicht Spring, sec. 30, T. 36 N., R. 12 W., two miles southeast of Swedeborg, Pulaski County.

Dominant Trees

Sycamore (<i>Platanus occidentalis</i>)	Silver maple (<i>Acer saccharinum</i>)
Black willow (<i>Salix nigra</i>)	American elm (<i>Ulmus americana</i>)

17. Alluvial banks along Big Piney River, between Dial's Camp, east of Big Piney and Ormsby's Place at Spring Creek crossing, T. 34-35 N., R. 10-11 W., Pulaski County.

Dominant Trees

Green ash (<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>)	Silver maple (<i>Acer saccharinum</i>)
	American elm (<i>Ulmus americana</i>)

Other Tree Associates

Cottonwood (<i>Populus deltoides</i>)	Shumard's red oak (<i>Quercus Shumardii</i>)
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18. Alluvial mud along Big Piney River, between Dial's Camp, east of Big Piney and Ormsby's Place at Spring Creek crossing, T. 34-35 N., R. 10-11 W., Pulaski County.

Dominant Trees

Black willow (<i>Salix nigra</i>)	Sycamore (<i>Platanus occidentalis</i>)
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Dominant Herbaceous Non-Grass Plants

Three-seeded mercury (<i>Acalypha rhomboidea</i>)	Clearweed (<i>Pilea pumila</i> var. <i>Deamii</i>)
Blue mist flower (<i>Eupatorium coelestinum</i>)	Spotted jewel-weed (<i>Impatiens biflora</i>)
Horseweed (<i>Ambrosia trifida</i>)	White vervain (<i>Verbena urticifolia</i>)
	Beefsteak plant (<i>Perilla frutescens</i>)

19. Mud flat along Osage River, sec. 2, T. 40 N., R. 13 W., west of Capps, Miller County.

Lady's thumb (<i>Polygonum pennsylvanicum</i>)	Cocklebur (<i>Xanthium chinense</i>)
Small white morning glory (<i>Ipomoea lacunosa</i>)	Button-weed (<i>Spermacoce glabra</i>)
	Panic grass (<i>Panicum dichotomiflorum</i>)
	Spurge (<i>Euphorbia maculata</i>)

(3) ***Ulmus americana*-*Fraxinus pensylvanica* var. *lanceolata***
Associates

20. Alluvial woods along Gasconade River, south of Hazel Green, Pulaski County.

Dominant Trees

Black willow (<i>Salix nigra</i>)	Green ash (<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>)
Silver maple (<i>Acer saccharinum</i>)	
Sycamore (<i>Platanus occidentalis</i>)	

Other Tree Associates

American elm (<i>Ulmus americana</i>)	Shumard's red oak (<i>Quercus Shumardii</i>)
River birch (<i>Betula nigra</i>)	Box elder (<i>Acer Negundo</i>)

Dominant Understory

Virginia creeper (<i>Parthenocissus quin-</i> <i>quefolia</i>)	Winter grape (<i>Vitis cinerea</i>) Frost grape (<i>Vitis cordifolia</i>)
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Other Understory Associates

Dutchman's pipe (<i>Aristolochia tomen-</i> <i>tosa</i>)	Hispid greenbrier (<i>Smilax hispida</i>)
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Dominant Herbaceous Non-Grass Plants

Blue mist flower (<i>Eupatorium coeles-</i> <i>tinum</i>)	Goldenrod (<i>Solidago serotina</i>) Sweet William (<i>Phlox paniculata</i>)
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21. Alluvial woods along Sniabar Creek, four and one-half miles south of Napoleon, Lafayette County.

Dominant Trees

Black willow (<i>Salix nigra</i>)	Cottonwood (<i>Populus deltoides</i>)
Green ash (<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>)	Silver maple (<i>Acer saccharinum</i>) Sycamore (<i>Platanus occidentalis</i>)

Other Tree Associates

Box elder (<i>Acer Negundo</i>)	Bur oak (<i>Quercus macrocarpa</i>)
American elm (<i>Ulmus americana</i>)	Hackberry (<i>Celtis occidentalis</i>)

22. Alluvial woods along Pomme de Terre River, three miles northeast of Elkland, Hickory County.

Dominant Trees

Green ash (<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>)	Sycamore (<i>Platanus occidentalis</i>)
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23. Low, alluvial woods along Noblett Creek, sec. 19, T. 26 N., R. 10 W., eight miles west of Burnham, Howell County.

Dominant Trees

Green ash (<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>)	Sycamore (<i>Platanus occidentalis</i>) American elm (<i>Ulmus americana</i>)
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Dominant Understory

Leatherwood (*Dirca palustris*)

24. Alluvial ground along King's River, south of Prentiss Ford, sec. 24, T. 21 N., R. 25 W., five miles south of Viola, in Barry County.

Dominant Trees

Green ash (<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>)	American elm (<i>Ulmus americana</i>) Sugar maple (<i>Acer saccharum</i> var. <i>glacum</i>)
Sycamore (<i>Platanus occidentalis</i>)	
River birch (<i>Betula nigra</i>)	

25. Low, alluvial woods along Gasconade River, east of Mossy Spring, sec. 2, T. 36 N., R. 11 W., seven miles northeast of Waynesville, Pulaski County.

Dominant Trees

- | | |
|---|--|
| Green ash (<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>) | American elm (<i>Ulmus americana</i>) |
| | Silver maple (<i>Acer saccharinum</i>) |

Other Tree Associates

- Bur oak (*Quercus macrocarpa*)

Dominant Understory

- | | |
|--|--|
| Buck brush (<i>Symphoricarpos orbiculatus</i>) | Poison ivy (<i>Toxicodendron radicans</i>) |
|--|--|

Other Understory Associates

- | | |
|--|---|
| Trumpet creeper (<i>Campsis radicans</i>) | Elderberry (<i>Sambucus canadensis</i>) |
| (Young) Silver maple (<i>Acer saccharinum</i>) | Hispid greenbrier (<i>Smilax hispida</i>) |
| (Young) Box elder (<i>Acer Negundo</i>) | Frost grape (<i>Vitis cordifolia</i>) |
| | Spicebush (<i>Benzoin aestivale</i>) |

Dominant Herbaceous Non-Grass Plants

- | | |
|---|--|
| Virginia knotweed (<i>Polygonum virginianum</i>) | Clear weed (<i>Pilea pumila</i> var. <i>Deamii</i>) |
| Common blue violet (<i>Viola papilionacea</i>) | Wild goldenglow (<i>Rudbeckia laciniata</i>) |
| Goldenrod (<i>Solidago serotina</i>) | Ironweed (<i>Vernonia altissima</i>) |
| Blue phlox (<i>Phlox divaricata</i> var. <i>Laphamii</i>) | Aster (<i>Aster lateriflorus</i> var. <i>pendulus</i>) |
| Ruellia (<i>Ruellia strepens</i>) | Juba bush (<i>Iresine rhizomatosa</i>) |
| | Three-seeded mercury (<i>Acalypha rhomboidea</i>) |

Other Herbaceous Non-Grass Plants

- | | |
|--|--|
| Blue mist flower (<i>Eupatorium coelestinum</i>) | Horseweed (<i>Ambrosia trifida</i>) |
| Beefsteak plant (<i>Perilla frutescens</i>) | Water pepper (<i>Polygonum punctatum</i>) |
| Spotted touch-me-not (<i>Impatiens biflora</i>) | False nettle (<i>Boehmeria cylindrica</i>) |
| | Black nightshade (<i>Solanum nigrum</i>) |

Dominant Grasses

- | | |
|--|---|
| White grass (<i>Leersia virginica</i>) | Thin grass (<i>Agrostis perennans</i> var. <i>aestivalis</i>) |
| Wild rye grass (<i>Elymus virginicus</i>) | |
| Wood reed grass (<i>Cinna arundinacea</i>) | |

26. Alluvial woods along Current River, sec. 34, T. 25 N., R. 1 E., six miles northeast of Bennett, Ripley County.

Dominant Trees

- | | |
|--|---|
| Shumard's red oak (<i>Quercus Shumardii</i>) | Sycamore (<i>Platanus occidentalis</i>) |
| American elm (<i>Ulmus americana</i>) | Black willow (<i>Salix nigra</i>) |
| White ash (<i>Fraxinus americana</i>) | Silver maple (<i>Acer saccharinum</i>) |
| Cottonwood (<i>Populus deltoides</i>) | |

27. Alluvial banks along Black River between Mill Spring and Williamsville, sec. 15, T. 27 N., R. 4 E., Wayne County.

Dominant Trees

- | | |
|--|---|
| Cottonwood (<i>Populus deltoides</i>) | American elm (<i>Ulmus americana</i>) |
| River birch (<i>Betula nigra</i>) | Sycamore (<i>Platanus occidentalis</i>) |
| Silver maple (<i>Acer saccharinum</i>) | |

Other Tree Associates

- | | |
|---|--|
| Green ash (<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>) | Shumard's red oak (<i>Quercus Shumardii</i>) |
|---|--|

Dominant Understory

Winter grape (<i>Vitis cinerea</i>)	Dutchman's pipe (<i>Aristolochia tomentosa</i>)
Raccoon grape (<i>Ampelopsis cordata</i>)	

Dominant Grasses

Spike grass (<i>Uniola latifolia</i>)	Switch cane (<i>Arundinaria gigantea</i>)
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28. Alluvial woods along Salt River at Asher Ford, south of Spalding, Ralls County.

Dominant Trees

Hackberry (<i>Celtis occidentalis</i> var. <i>canina</i>)	American elm (<i>Ulmus americana</i>)
	Bur oak (<i>Quercus macrocarpa</i>)

Other Tree Associates

Red mulberry (<i>Morus rubra</i>)	Honey locust (<i>Gleditsia triacanthos</i>)
Red haw (<i>Crataegus mollis</i>)	Sycamore (<i>Platanus occidentalis</i>)

Dominant Understory

Elderberry (<i>Sambucus canadensis</i>)	Bristly greenbrier (<i>Smilax hispida</i>)
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Dominant Herbaceous Non-Grass Plants

Aster (<i>Aster lateriflorus</i> var. <i>pendulus</i>)	Three-seeded mercury (<i>Acalypha rhomboidea</i>)
Climbing buckwheat (<i>Polygonum scandens</i>)	Goldenrod (<i>Solidago serotina</i>)
One-seeded bur cucumber (<i>Sicyos angulatus</i>)	Clearweed (<i>Pilea pumila</i> var. <i>Deamii</i>)
Pale-flowered touch-me-not (<i>Impatiens pallida</i>)	Horseweed (<i>Ambrosia trifida</i>)
	Actinomeris (<i>Actinomeris alternifolia</i>)
	Slender nettle (<i>Urtica procera</i>)

Dominant Grasses

Wild rye (<i>Elymus canadensis</i>)	White grass (<i>Leersia virginica</i>)
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29. Alluvial woods along Hazel Creek, sec. 14, T. 36 N., R. 1 W., one mile southwest of Palmer, Washington County.

Dominant Trees

Sycamore (<i>Platanus occidentalis</i>)	Black cherry (<i>Prunus serotina</i>)
American elm (<i>Ulmus americana</i>)	White ash (<i>Fraxinus americana</i>)
Honey locust (<i>Gleditsia triacanthos</i> var. <i>inermis</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
Bur oak (<i>Quercus macrocarpa</i>)	Shingle oak (<i>Quercus imbricaria</i>)

Dominant Understory

Smooth alder (<i>Alnus rugosa</i>)	Redbud (<i>Cercis canadensis</i>)
Ward's willow (<i>Salix longipes</i> var. <i>Wardii</i>)	Button-bush (<i>Cephalanthus occidentalis</i>)
	Ironwood (<i>Carpinus caroliniana</i>)

30. Alluvial woods along spring branch of Montauk Spring in Montauk State Park, near Montauk, Dent County.

Dominant Trees

River birch (<i>Betula nigra</i>)	American elm (<i>Ulmus americana</i>)
Black walnut (<i>Juglans nigra</i>)	Black willow (<i>Salix nigra</i>)
Shingle oak (<i>Quercus imbricaria</i>)	

Dominant Understory

Chittim-wood (*Bumelia lanuginosa*) Black haw (*Viburnum rufidulum*)
 Smooth alder (*Alnus rugosa*)

31. Alluvial, lime-bouldered banks along White River between Forsyth and Moore's Ferry, Taney County.

Dominant Trees

Sugar maple (*Acer saccharum* var. *glaucum*) Green ash (*Fraxinus pensylvanica* var. *lanceolata*)
 American elm (*Ulmus americana*)

Other Tree Associates

Hackberry (*Celtis occidentalis*) Bur oak (*Quercus macrocarpa*)
 River birch (*Betula nigra*) Shumard's red oak (*Quercus Shumardii*)
 Catalpa (*Catalpa speciosa*)

Dominant Understory

Ironwood (*Carpinus caroliniana*) Swamp privet (*Forestiera acuminata*)

32. Alluvial woods at Hall's Bluff, south of Davidson's Blue Spring along Black River, sec. 4, T. 27 N., R. 4 E., four miles south-east of Mill Spring, Wayne County.

Dominant Trees

Box elder (*Acer Negundo*) Hackberry (*Celtis occidentalis*)
 American elm (*Ulmus americana*) Sweet gum (*Liquidambar styraciflua*)

(4) *Acer saccharum*—*Carya cordiformis* Associates

33. Alluvial woods along Eleven Points River, sec. 18, T. 24 N., R. 2 W., three and one-half miles south of Wilderness, Oregon County.

Dominant Trees

American elm (*Ulmus americana*) Sycamore (*Platanus occidentalis*)

Other Tree Associates

Shumard's red oak (*Quercus Shumardii*) Chinquapin oak (*Quercus Muhlenbergii*)
 Bur oak (*Quercus macrocarpa*) Linden (*Tilia glabra*)
 Black willow (*Salix nigra*) Bitternut hickory (*Carya cordiformis*)
 River birch (*Betula nigra*) Pignut hickory (*Carya ovalis* var. *obovatis*)
 Northern red oak (*Quercus borealis* var. *maxima*)
 Persimmon (*Diospyros virginiana*)

Dominant Understory

Pawpaw (*Asimina triloba*)

Other Understory Associates

Button-bush (*Cephalanthus occidentalis*) Ironwood (*Carpinus caroliniana*)
 Hop tree (*Ptelea trifoliata*) Chittim-wood (*Bumelia lanuginosa*)

34. Alluvial woods at base of west-facing limestone slopes along Otter Creek, sec. 18, T. 27 N., R. 6 E., near Taskee, Wayne County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Winged elm (<i>Ulmus alata</i>)
Sycamore (<i>Platanus occidentalis</i>)	American elm (<i>Ulmus americana</i>)
Bitternut hickory (<i>Carya cordiformis</i>)	Box elder (<i>Acer Negundo</i>)
	River birch (<i>Betula nigra</i>)

Dominant Understory

Button-bush (<i>Cephalanthus occidentalis</i>)	Red-flowered buckeye (<i>Aesculus discolor</i> var. <i>mollis</i>)
Hop hornbeam (<i>Ostrya virginiana</i>)	Spicebush (<i>Benzoin aestivale</i>)
Alder (<i>Alnus rugosa</i>)	Persimmon (<i>Diospyros virginiana</i>)
Mulberry (<i>Morus rubra</i>)	Hazelnut (<i>Corylus americana</i>)
Black haw (<i>Viburnum rufidulum</i>)	

This is not an alluvial flora as developed on large streams or flood plains, but is partly alluvial and partly some of the flora of the adjacent lower slopes.

35. Alluvial woods along Huzzah Creek, two miles southeast of Davisville, Crawford County.

Dominant Tree

Sugar maple (*Acer saccharum* var. *glaucum*)

Other Tree Associates

American elm (<i>Ulmus americana</i>)	Butternut (<i>Juglans cinerea</i>)
Green ash (<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>)	Blue ash (<i>Fraxinus quadrangulata</i>)
Sycamore (<i>Platanus occidentalis</i>)	Honey locust (<i>Gleditsia triacanthos</i>)
Bur oak (<i>Quercus macrocarpa</i>)	Big shell-bark hickory (<i>Carya laciniosa</i>)

Dominant Understory

Ironwood (<i>Carpinus caroliniana</i>)	Pawpaw (<i>Asimina triloba</i>)
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Other Understory Associates

Ohio buckeye (<i>Aesculus glabra</i> f. <i>pallida</i>)	Raccoon grape (<i>Ampelopsis cordata</i>)
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Dominant Herbaceous Non-Grass Plants

Beggar's lice (<i>Lappula virginiana</i>)	Three-seeded mercury (<i>Acalypha rhomboidea</i>)
Beefsteak plant (<i>Perilla frutescens</i>)	

36. Rich woods built up on alluvial formation at the base of Hall's Bluff, south of Davidson's Blue Spring along Black River, sec. 4, T. 27 N., R. 4 E., four miles southeast of Mill Spring, Wayne County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Mulberry (<i>Morus rubra</i>)
Kentucky coffee tree (<i>Gymnocladus dioica</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
Walnut (<i>Juglans nigra</i>)	Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)
Butternut (<i>Juglans cinerea</i>)	Persimmon (<i>Diospyros virginiana</i>)
	Hackberry (<i>Celtis laevigata</i>)

Dominant Understory

Spicebush (<i>Benzoin aestivale</i>)	Pawpaw (<i>Asimina triloba</i>)
American hornbeam (<i>Carpinus caroliniana</i>)	Flowering dogwood (<i>Cornus florida</i>)
American bladdernut (<i>Staphylea trifolia</i>)	Hazelnut (<i>Corylus americana</i>)
	Greenbrier (<i>Smilax hispida</i>)

Dominant Herbaceous Non-Grass Plants

Honewort (<i>Cryptotaenia canadensis</i>)	Virginia tickseed (<i>Lappula virginiana</i>)
Blue phlox (<i>Phlox divaricata</i> var. <i>Laphamii</i>)	Bloodroot (<i>Sanguinaria canadensis</i>)
Virginia knotweed (<i>Polygonum virginianum</i>)	Maidenhair fern (<i>Adiantum pedatum</i>)
	Jack-in-the-pulpit (<i>Arisaema triphyllum</i>)

Dominant Grass

Fescue grass (*Festuca obtusa*)

37. Rich, alluvial bottom woods along Cane Creek, sec. 17, T. 26 N., R. 4 E., six miles southwest of Williamsville, Wayne County.

Dominant Trees

Bitternut hickory (<i>Carya cordiformis</i>)	American elm (<i>Ulmus americana</i>)
White oak (<i>Quercus alba</i>)	Sweet gum (<i>Liquidambar styraciflua</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	River birch (<i>Betula nigra</i>)
Shingle oak (<i>Quercus imbricaria</i>)	Honey locust (<i>Gleditsia triacanthos</i>)
American ash (<i>Fraxinus americana</i>)	Silver maple (<i>Acer saccharinum</i>)
Walnut (<i>Juglans nigra</i>)	Cottonwood (<i>Populus deltoides</i>)
Mulberry (<i>Morus rubra</i>)	Sycamore (<i>Platanus occidentalis</i>)

Dominant Understory

American hornbeam (<i>Carpinus caroliniana</i>)	Buck brush (<i>Symphoricarpos orbiculatus</i>)
Flowering dogwood (<i>Cornus florida</i>)	Hazelnut (<i>Corylus americana</i>)
Redbud (<i>Cercis canadensis</i>)	Pawpaw (<i>Asimina triloba</i>)
Black haw (<i>Viburnum rufidulum</i>)	Alder (<i>Alnus rugosa</i>)
Red-flowering buckeye (<i>Aesculus discolor</i> var. <i>mollis</i>)	Elderberry (<i>Sambucus canadensis</i>)

Dominant Grasses

Spike grass (<i>Uniola latifolia</i>)	Fowl meadow grass (<i>Glyceria striata</i>)
Wood reed grass (<i>Cinna arundinacea</i>)	

38. Along Ten Mile Creek, loaded with chert from adjacent slopes, sec. 9, T. 25 N., R. 4 E., 13 miles northwest of Poplar Bluff, Butler County.

Dominant Trees

Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Red maple (<i>Acer rubrum</i>)
White oak (<i>Quercus alba</i>)	Silver maple (<i>Acer saccharinum</i>)
Shingle oak (<i>Quercus imbricaria</i>)	White ash (<i>Fraxinus americana</i>)
River birch (<i>Betula nigra</i>)	Sweet gum (<i>Liquidambar styraciflua</i>)
Mockernut hickory (<i>Carya tomentosa</i>)	Winged elm (<i>Ulmus alata</i>)

Dominant Understory

- | | |
|--|--|
| Ozark witch hazel (<i>Hamamelis vernalis</i>) | Smooth alder (<i>Alnus rugosa</i>) |
| Ward's willow (<i>Salix longipes</i> var. <i>Wardii</i>) | Button-bush (<i>Cephalanthus occidentalis</i>) |

Other Understory Associates

- | | |
|--|--|
| Persimmon (<i>Diospyros virginiana</i>) | Chittim-wood (<i>Bumelia lanuginosa</i>) |
| Black haw (<i>Viburnum prunifolium</i>) | Red-flowered buckeye (<i>Aesculus discolor</i> var. <i>mollis</i>) |
| Black haw (<i>Viburnum rufidulum</i>) | Ironwood (<i>Carpinus caroliniana</i>) |
| Buck brush (<i>Symphoricarpos orbiculatus</i>) | Shadbush, serviceberry (<i>Amelanchier canadensis</i>) |
| Dogwood (<i>Cornus florida</i>) | Ninebark (<i>Physocarpus opulifolius</i> var. <i>intermedius</i>) |
| Dwarf sumac (<i>Rhus Copallina</i>) | Hop tree (<i>Ptelea trifoliata</i>) |
| Smooth sumac (<i>Rhus glabra</i>) | |
| Deerberry (<i>Vaccinium stamineum</i> var. <i>neglectum</i>) | |

Dominant Herbaceous Non-Grass Plants

- | | |
|--|---|
| Rough button-weed (<i>Diodia teres</i> var. <i>setigera</i>) | Water willow (<i>Dianthera americana</i>) |
|--|---|

39. Rich, low woods along Big Barren Creek, near "Blue Spring," sec. 4, T. 25 N., R. 1 W., two and one-half miles southwest of Eastwood, 10 miles northwest of Bennett, Carter County.

Dominant Trees

- | | |
|--|---|
| Linden (<i>Tilia glabra</i>) | Northern red oak (<i>Quercus borealis</i> var. <i>mazima</i>) |
| Bitternut hickory (<i>Carya cordiformis</i>) | Sycamore (<i>Platanus occidentalis</i>) |
| White ash (<i>Fraxinus americana</i>) | Winged elm (<i>Ulmus alata</i>) |
| American elm (<i>Ulmus americana</i>) | Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>) |
| Butternut (<i>Juglans cinerea</i>) | |
| White oak (<i>Quercus alba</i>) | |
| Chinquapin oak (<i>Quercus Muhlenbergii</i>) | |

Dominant Understory

- | | |
|--|--|
| Ironwood (<i>Carpinus caroliniana</i>) | Fragrant sumac (<i>Rhus aromatica</i>) |
| Spicebush (<i>Benzoin aestivale</i>) | Buck brush (<i>Symphoricarpos orbiculatus</i>) |
| Hazelnut (<i>Corylus americana</i>) | Redbud (<i>Cercis canadensis</i>) |
| Black haw (<i>Viburnum rufidulum</i>) | |

40. Alluvial woods along Eleven Points River opposite west-facing slopes, sec. 11, T. 24 N., R. 3 W., one mile southeast of Turner's Mill, four miles southwest of Wilderness, Oregon County.

Dominant Trees

- | | |
|---|---|
| American elm (<i>Ulmus americana</i>) | Sycamore (<i>Platanus occidentalis</i>) |
|---|---|

Other Tree Associates

- | | |
|---|---|
| Shumard's red oak (<i>Quercus Shumardii</i>) | Persimmon (<i>Diospyros virginiana</i>) |
| Bur oak (<i>Quercus macrocarpa</i>) | Linden (<i>Tilia glabra</i>) |
| Black willow (<i>Salix nigra</i>) | Butternut (<i>Juglans cinerea</i>) |
| River birch (<i>Betula nigra</i>) | Bitternut hickory (<i>Carya cordiformis</i>) |
| Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>) | Pignut hickory (<i>Carya ovalis</i> var. <i>obovatis</i>) |
| Chinquapin oak (<i>Quercus Muhlenbergii</i>) | |

Dominant Understory

- | |
|-----------------------------------|
| Pawpaw (<i>Asimina triloba</i>) |
|-----------------------------------|

Other Understory Associates

Button-bush (<i>Cephalanthus occidentalis</i>)	Ironwood (<i>Carpinus caroliniana</i>)
Hop tree (<i>Ptelea trifoliata</i>)	Dogwood (<i>Cornus florida</i>)
Chittim-wood (<i>Bumelia lanuginosa</i>)	

41. Low, alluvial woods around Iron Mountain Lake, five miles south of Bismarck, St. Francois County.

Dominant Trees

Black willow (<i>Salix nigra</i>)	Bitternut hickory (<i>Carya cordiformis</i>)
Swamp white oak (<i>Quercus bicolor</i>)	Shagbark hickory (<i>Carya ovata</i>)
Shingle oak (<i>Quercus imbricaria</i>)	White ash (<i>Fraxinus americana</i>)
White oak (<i>Quercus alba</i>)	Sycamore (<i>Platanus occidentalis</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Black walnut (<i>Juglans nigra</i>)
Red maple (<i>Acer rubrum</i>)	Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)
American elm (<i>Ulmus americana</i>)	

Dominant Shrubs

Hazelnut (<i>Corylus americana</i>)	Smooth alder (<i>Alnus rugosa</i>)
Bristly greenbrier (<i>Smilax hispida</i>)	

42. Wooded valley floor along Brazil Creek, sec. 28, T. 38 N., R. 1 W., six miles northeast of Berryman, Washington County.

Dominant Trees

White oak (<i>Quercus alba</i>)	Sycamore (<i>Platanus occidentalis</i>)
Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Bitternut hickory (<i>Carya cordiformis</i>)

Dominant Understory

Flowering dogwood (<i>Cornus florida</i>)	Hop hornbeam (<i>Ostrya virginiana</i>)
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43. Alluvial woods along Bee Fork of Black River, sec. 23, T. 32 N., R. 1 W., four miles northwest of Centerville, Reynolds County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Black walnut (<i>Juglans nigra</i>)
Butternut (<i>Juglans cinerea</i>)	Sycamore (<i>Platanus occidentalis</i>)
Chinquapin oak (<i>Quercus Muhlenbergii</i>)	American elm (<i>Ulmus americana</i>)

Dominant Understory

Ironwood (<i>Carpinus caroliniana</i>)	Buck brush (<i>Symphoricarpos orbiculatus</i>)
Pawpaw (<i>Asimina triloba</i>)	
Leatherwood (<i>Dirca palustris</i>)	Flowering dogwood (<i>Cornus florida</i>)
Elderberry (<i>Sambucus canadensis</i>)	Frost grape (<i>Vitis cordifolia</i>)

44. Alluvial woods along Brushy Creek, sec. 24, T. 32 N., R. 1 W., one mile north of Moses Store, Reynolds County.

Dominant Trees

Shumard's red oak (<i>Quercus Shumardii</i>)	Bitternut hickory (<i>Carya cordiformis</i>)
American elm (<i>Ulmus americana</i>)	Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)
Sycamore (<i>Platanus occidentalis</i>)	
Butternut (<i>Juglans cinerea</i>)	

Dominant Understory

Pawpaw (<i>Asimina triloba</i>)	Buck brush (<i>Symphoricarpos orbiculatus</i>)
Spicebush (<i>Benzoin aestivale</i>)	
Moonseed (<i>Menispermum canadense</i>)	

45. Alluvial woods along Big Piney River, nine miles west of Licking, Texas County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Hackberry (<i>Celtis occidentalis</i> var. <i>canina</i>)
Sycamore (<i>Platanus occidentalis</i>)	Black walnut (<i>Juglans nigra</i>)
River birch (<i>Betula nigra</i>)	White oak (<i>Quercus alba</i>)
American elm (<i>Ulmus americana</i>)	Bur oak (<i>Quercus macrocarpa</i>)
White ash (<i>Fraxinus americana</i>)	Shumard's red oak (<i>Quercus Shumardii</i>)
Black gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)	

Dominant Understory

Ohio buckeye (*Aesculus glabra* f. *pallida*)

46. Alluvial woods along Big Creek, sec. 22, T. 31 N., R. 3 W., one and one-half miles west of Rat, Shannon County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Shumard's red oak (<i>Quercus Shumardii</i>)
	Sycamore (<i>Platanus occidentalis</i>)

Other Tree Associates

Bitternut hickory (<i>Carya cordiformis</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
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Dominant Understory

Leatherwood (<i>Dirca palustris</i>)	Pawpaw (<i>Asimina triloba</i>)
Ironwood (<i>Carpinus caroliniana</i>)	

Other Understory Associates

Buck brush (<i>Symphoricarpos orbiculatus</i>)	Flowering dogwood (<i>Cornus florida</i>)
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Dominant Herbaceous Non-Grass Plant

Beefsteak plant (*Perilla frutescens*)

II. ACER SACCHARUM-QUERCUS ALBA ASSOCIATION**(2) Juniperus virginiana-Rhus trilobata var. serotina Associes**

47. Upland limestone glade of bald knob in Hercules Game Refuge, sec. 10-11, T. 24 N., R. 18 W., two miles southwest of Hercules, Taney County.

Dominant Tree

Smoke-tree (*Cotinus americanus*)

Other Tree Associates

Persimmon (*Diospyros virginiana*) Red cedar (*Juniperus virginiana*)

Dominant Understory

Fragrant sumac (*Rhus trilobata* var. *serotina*) Greenbrier (*Smilax Bona-nor*)

Understory Associate

Buck brush (*Symphoricarpos orbiculatus*)

Dominant Herbaceous Non-Grass Plants

Prairie clover (*Petalostemum purpureum*) Heliotropium *tenellum*
 Stinging nettle (*Tragia urticaefolia*) Sandwort (*Arenaria patula*)
 Hogwort (*Croton capitatus*) Palafoxia *callosa*
Linum sulcatum

Dominant Grasses

Side-oats grama (*Bouteloua curtipendula*) Big blue-stem (*Andropogon provincialis*)

48. Limestone bald knobs around Swan U. S. Lookout Tower, sec. 20, T. 25 N., R. 18 W., four miles east of Garrison, Christian County.

Dominant Trees

Persimmon (*Diospyros virginiana*) Winged elm (*Ulmus alata*)
 Red cedar (*Juniperus virginiana*)

Dominant Understory

Supple-jack (*Berchemia scandens*)

Dominant Herbaceous Non-Grass Plants

Calamint (*Satureja glabella* var. *angustifolia*)

Other Herbaceous Non-Grass Plant Associates

Blue false indigo (*Baptisia minor*) Black-eyed Susan (*Rudbeckia missouriensis*)
 Feverfew (*Parthenium hispidum*)

Dominant Grass

Side-oats grama (*Bouteloua curtipendula*)

49. Limestone slopes in small ravine between upper exposed parts of bald knobs in Hercules Game Refuge, sec. 10-11, T. 24 N., R. 18 W., two miles southwest of Hercules, Taney County.

Dominant Trees

Schneck's red oak (*Quercus Shumardii* var. *Schneckii*) Smoke tree (*Cotinus americanus*)
 Chinquapin oak (*Quercus Muhlenbergii*)

Other Tree Associates

Redbud (*Cercis canadensis*) Fringe tree (*Chionanthus virginica*)

Dominant Understory

Fragrant sumac, pole-cat bush (*Rhus trilobata* var. *serotina*)

(4) *Ulmus alata*-*Rhamnus caroliniana* Associates

50. Low woods along branch in Stilwell Hollow, Low Gap Game Refuge, southeast of Black U. S. Lookout, sec. 12, T. 32 N., R. 1 E., four miles southwest of Black, Reynolds County.

Dominant Trees

Winged elm (<i>Ulmus alata</i>)	White ash (<i>Fraxinus americana</i>)
Bitternut hickory (<i>Carya cordiformis</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)

Dominant Understory

Pawpaw (<i>Asimina triloba</i>)	Redbud (<i>Cercis canadensis</i>)
Buck brush (<i>Symphoricarpos orbiculatus</i>)	

Dominant Herbaceous Non-Grass Plant

Beefsteak plant (*Perilla frutescens*)

(5) *Quercus Muhlenbergii*-*Fraxinus americana* Associates

51. Limestone glades and ledges on bluffs along East Fork of Bull Creek, sec. 26, T. 26 N., R. 20 W., three miles southwest of Chadwick, Christian County.

Dominant Trees

Schneck's red oak (<i>Quercus Schumardii</i> var. <i>Schneckii</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
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Dominant Shrubs

Chittim-wood (<i>Bumelia lanuginosa</i>)	Winged elm (<i>Ulmus alata</i>)
Black haw (<i>Viburnum rufidulum</i>)	

Other Shrub Associates

Redbud (<i>Cercis canadensis</i>)	Persimmon (<i>Diospyros virginiana</i>)
Indian cherry (<i>Rhamnus caroliniana</i>)	Rough-leaved dogwood (<i>Cornus asperifolia</i>)
Fragrant sumac (<i>Rhus trilobata</i> var. <i>serotina</i>)	

Dominant Herbaceous Non-Grass Plants

Black-eyed Susan (<i>Rudbeckia missouriensis</i>)	<i>Houstonia nigricans</i>
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Other Herbaceous Non-Grass Plant Associates

Wine-cups (<i>Callirhoe digitata</i>)	Gum-plant (<i>Grindelia lanceolata</i>)
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Dominant Grasses

Blue-stem (<i>Andropogon scoparius</i> var. <i>genuinus</i>)	Side-oats grama (<i>Bouteloua curtipendula</i>)
	Big blue-stem (<i>Andropogon provincialis</i>)

52. Limestone bluffs along Hazel Creek, sec. 14, T. 36 N., R. 1 W., one mile southwest of Palmer, Washington County.

Dominant Trees

Slippery elm (<i>Ulmus fulva</i>)	White ash (<i>Fraxinus americana</i>)
Chinquapin oak (<i>Quercus Muhlenbergii</i>)	

Dominant Understory

- | | |
|--|---|
| Rough-leaved dogwood (<i>Cornus asperifolia</i>) | Swamp dogwood (<i>Cornus obliqua</i>) |
| | Black haw (<i>Viburnum rufidulum</i>) |

53. Northwest-facing slopes along Marble Creek, sec. 20, T. 32 N., R. 5 E., two miles southwest of French Mills, Madison County.

Dominant Trees

- | | |
|---|---|
| Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>) | Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>) |
| Chinquapin oak (<i>Quercus Muhlenbergii</i>) | |

Other Tree Associates

- | | |
|---|--|
| White ash (<i>Fraxinus americana</i>) | Linden (<i>Tilia glabra</i>) |
| Butternut (<i>Juglans cinerea</i>) | American elm (<i>Ulmus americana</i>) |
| Kentucky coffee tree (<i>Gleditsia triacanthos</i>) | Blue ash (<i>Fraxinus quadrangulata</i>) |
| | Slippery elm (<i>Ulmus fulva</i>) |

Dominant Understory

- | | |
|---|---|
| Indian cherry (<i>Rhamnus caroliniana</i>) | Black haw (<i>Viburnum rufidulum</i>) |
| Ninebark (<i>Physocarpus opulifolius</i> var. <i>intermedius</i>) | Hop hornbeam (<i>Ostrya virginiana</i>) |
| | Red cedar (<i>Juniperus virginiana</i>) |

54. Lower, west-facing, limestone slopes along Eleven Points River, sec. 11, T. 24 N., R. 3 W., one mile southeast of Turner's Mill, four miles southwest of Wilderness, Oregon County.

Dominant Trees

- | | |
|--|--|
| Chinquapin oak (<i>Quercus Muhlenbergii</i>) | Hackberry (<i>Celtis occidentalis</i>) |
| White ash (<i>Fraxinus americana</i>) | American elm (<i>Ulmus americana</i>) |
| Redbud (<i>Cercis canadensis</i>) | Blue ash (<i>Fraxinus quadrangulata</i>) |
| Butternut (<i>Juglans cinerea</i>) | Shumard's red oak (<i>Quercus Shumardii</i>) |
| Linden (<i>Tilia glabra</i>) | Box elder (<i>Acer Negundo</i>) |
| Sugar maple (<i>Acer saccharum</i>) | |

Dominant Understory

- | | |
|--|--|
| Buck brush (<i>Symphoricarpos orbiculatus</i>) | American bladdernut (<i>Staphylea trifolia</i>) |
| Pawpaw (<i>Asimina triloba</i>) | Black haw (<i>Viburnum rufidulum</i>) |
| Ironwood (<i>Carpinus caroliniana</i>) | Rough-leaved dogwood (<i>Cornus asperifolia</i>) |
| Spicebush (<i>Benzoin aestivale</i>) | |
| Red mulberry (<i>Morus rubra</i>) | |

55. West-facing, wooded, limestone slopes along Castor River, at Hahn's Mill, sec. 16, T. 33 N., R. 8 E., four miles northeast of Cornwall, Madison County.

Dominant Trees

- | | |
|---|---|
| Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>) | Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>) |
| White oak (<i>Quercus alba</i>) | |

Other Tree Associates

- | | |
|---|--|
| Red maple (<i>Acer rubrum</i>) | Linden (<i>Tilia glabra</i>) |
| White ash (<i>Fraxinus americana</i>) | Chinquapin oak (<i>Quercus Muhlenbergii</i>) |
| Shagbark hickory (<i>Carya ovata</i>) | |

Dominant UnderstoryIronwood (*Carpinus caroliniana*)**Other Understory Associates**

Black haw (<i>Viburnum rufidulum</i>)	Hop hornbeam (<i>Ostrya virginiana</i>)
Flowering dogwood (<i>Cornus florida</i>)	Bladdernut (<i>Staphylea trifolia</i>)
Smooth alder (<i>Alnus rugosa</i>)	

56. North-facing, wooded, limestone slopes along Brazil Creek, sec. 28, T. 38 N., R. 1 W., six miles northeast of Berryman, Washington County.

UPPER PORTION OF SLOPES**Dominant Trees**

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Schneck's red oak (<i>Quercus Shumardii</i> var. <i>Schneckii</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)

LOWER PORTION OF SLOPES**Dominant Trees**

Linden (<i>Tilia glabra</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	American elm (<i>Ulmus americana</i>)

Dominant Understory

Chittim-wood (<i>Bumelia lanuginosa</i>)	Redbud (<i>Cercis canadensis</i>)
Black haw (<i>Viburnum rufidulum</i>)	Ironwood (<i>Carpinus caroliniana</i>)
Indian cherry (<i>Rhamnus caroliniana</i> var. <i>mollis</i>)	Bladdernut (<i>Staphylea trifolia</i>)
	Hackberry (<i>Celtis pumila</i> var. <i>georgiana</i>)

57. One-half to two-thirds the way up south-facing limestone slopes along Bee Fork of Black River, sec. 29, T. 32 N., R. 1 W., seven miles west of Centerville, Reynolds County.

Dominant TreeChinquapin oak (*Quercus Muhlenbergii*)**Tree Associate**Shagbark hickory (*Carya ovata*)**Dominant Understory**

Flowering dogwood (<i>Cornus florida</i>)	Black haw (<i>Viburnum rufidulum</i>)
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Other Understory Associates

Hop hornbeam (<i>Ostrya virginiana</i>)	Chittim-wood (<i>Bumelia lanuginosa</i>)
Greenbrier (<i>Smilax Bona-nox</i>)	

58. Two-thirds to three-fourths the way up south-facing limestone slopes along Bee Fork of Black River, sec. 29, T. 32 N., R. 1 W., seven miles west of Centerville, Reynolds County.

Dominant Trees

Schneck's red oak (*Quercus Shumardii* var. *Schneckii*) White oak (*Quercus alba*)

Other Tree Associates

Post oak (*Quercus stellata*) Slippery elm (*Ulmus fulva*)
Shingle oak (*Quercus imbricaria*) Persimmon (*Diospyros virginiana*)

Dominant Understory

Dwarf hackberry (*Celtis pumila* var. *georgiana*) Wild plum (*Prunus americana*)

59. Base of limestone slopes along Eleven Points River, sec. 11, T. 24 N., R. 3 W., one mile southeast of Turner's Mill, four miles southwest of Wilderness, Oregon County.

Dominant Trees

Northern red oak (*Quercus borealis* var. *maxima*) American elm (*Ulmus americana*)
Chinquapin oak (*Quercus Muhlenbergii*) White ash (*Fraxinus americana*)
Linden (*Tilia glabra*) Black walnut (*Juglans nigra*)

Tree Associate

Persimmon (*Diospyros virginiana*)

Dominant Understory

American bladdernut (*Staphylea trifolia*) Pawpaw (*Asimina triloba*)
Redbud (*Cercis canadensis*)

Other Understory Associates

Ironwood (*Carpinus caroliniana*) Hazelnut (*Corylus americana*)
Spicebush (*Benzoin aestivale*) Black haw (*Viburnum rufidulum*)

60. West-facing limestone slopes along Current River, sec. 34, T. 25 N., R. 1 E., five miles northeast of Bennett, Ripley County.

Dominant Trees

Sugar maple (*Acer saccharum*) Persimmon (*Diospyros virginiana*)
Sweet gum (*Liquidambar styraciflua*) White ash (*Fraxinus americana*)
Linden (*Tilia glabra*) Red cedar (*Juniperus virginiana*)
Chinquapin oak (*Quercus Muhlenbergii*)

Dominant Understory

Black haw (*Viburnum rufidulum*) Ninebark (*Physocarpus opulifolius* var. *intermedius*)
Redbud (*Cercis canadensis*) Ironwood (*Carpinus caroliniana*)
Possum haw (*Ilex decidua*) Indian cherry (*Rhamnus caroliniana*)
Hop hornbeam (*Ostrya virginiana*) Sassafras (*Sassafras albidum* var. *molle*)
Rough-leaved dogwood (*Cornus asperifolia*)

Dominant Herbaceous Non-Grass Plants

Dutchman's pipe (*Aristolochia tomentosa*) Rattle weed (*Astragalus canadensis*)

Dominant Grass

Switch cane (*Arundinaria gigantea*)

64. At base of south-facing limestone slopes along Bee Fork of Black River, sec. 29, T. 32 N., R. 1 W., seven miles west of Centerville, Reynolds County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Slippery elm (<i>Ulmus fulva</i>)
White oak (<i>Quercus alba</i>)	Winged elm (<i>Ulmus alata</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
	Red mulberry (<i>Morus rubra</i>)
	Bitternut hickory (<i>Carya cordiformis</i>)

Tree Associate

Persimmon (*Diospyros virginiana*)

Dominant Understory

Black haw (<i>Viburnum rufidulum</i>)	Redbud (<i>Cercis canadensis</i>)
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Other Understory Associates

Fragrant sumac (<i>Rhus aromatica</i>)	Ironwood (<i>Carpinus caroliniana</i>)
Greenbrier (<i>Smilax Bona-nox</i>)	Smooth sumac (<i>Rhus glabra</i>)
Frost grape (<i>Vitis cordifolia</i>)	

65. Northeast-facing, limestone, wooded slopes along Black River, north of Markham Spring, sec. 23, T. 27 N., R. 4 E., three miles west of Williamsville, Wayne County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	American elm (<i>Ulmus americana</i>)
Chinquapin oak (<i>Quercus Muhlenbergii</i>)	White ash (<i>Fraxinus americana</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Sweet gum (<i>Liquidambar styraciflua</i>)
Butternut (<i>Juglans cinerea</i>)	Sycamore (<i>Platanus occidentalis</i>)
	Bitternut hickory (<i>Carya cordiformis</i>)
	Linden (<i>Tilia glabra</i>)

Dominant Understory

Ironwood (<i>Carpinus caroliniana</i>)	Frost grape (<i>Vitis cordifolia</i>)
Rough-leaved dogwood (<i>Cornus asperifolia</i>)	Button-bush (<i>Cephalanthus occidentalis</i>)
Spicebush (<i>Benzoin aestivale</i>)	Black haw (<i>Viburnum rufidulum</i>)
American bladdernut (<i>Staphylea trifolia</i>)	Burning bush (<i>Euonymus atropurpureus</i>)
Hydrangea (<i>Hydrangea arborescens</i>)	Hop hornbeam (<i>Ostrya virginiana</i>)
Flowering dogwood (<i>Cornus florida</i>)	Poison ivy (<i>Toxicodendron radicans</i>)
Bristly greenbrier (<i>Smilax hispida</i>)	Smooth alder (<i>Alnus rugosa</i>)

Dominant Herbaceous Non-Grass Plant

Liverleaf (*Hepatica acutiloba*)

Dominant Grasses

Fescue grass (<i>Festuca obtusa</i>)	Switch cane (<i>Arundinaria gigantea</i>)
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66. Along south-facing limestone bluffs of King's River, one mile southwest of Prentiss Ford, sec. 19-24, T. 21 N., R. 25 W., five miles south of Viola, Barry County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
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Other Tree Associates

Yellow-wood (<i>Cladrastis lutea</i>)	Red mulberry (<i>Morus rubra</i>)
American elm (<i>Ulmus americana</i>)	Black walnut (<i>Juglans nigra</i>)

Dominant UnderstoryRedbud (*Cercis canadensis*)Hackberry (*Celtis occidentalis*)**Other Understory Associates**Indian cherry (*Rhamnus caroliniana*
var. *mollis*)Spicebush (*Benzoin aestivale*)Red cedar (*Juniperus virginiana*)Black haw (*Viburnum rufidulum*)Pawpaw (*Asimina triloba*)Buck brush (*Symphoricarpos orbiculatus*)**Dominant Herbaceous Non-Grass Plants**White snakeroot (*Eupatorium urticaefolium*)Thimble weed (*Anemone virginiana*)Black snakeroot (*Sanicula canadensis*)Beggar's ticks (*Desmodium acuminatum*)**Other Herbaceous Non-Grass Plants**Frost grape (*Vitis cordifolia*)Solomon's seal (*Polygonatum canaliculatum*)Yellow violet (*Viola eriocarpa*)Lopseed (*Phryma leptostachya*)Virgin's bower (*Clematis virginiana* var. *missouriensis*)American bellflower (*Campanula americana*)Leather flower (*Clematis versicolor*)Wild licorice (*Galium circaezans* var. *hypomalacum*)Skull-cap (*Scutellaria ovata*)Virginia knotweed (*Polygonum virginianum*)Skull-cap (*Scutellaria ovalifolia*)Bear grass (*Yucca arkansana*)**Dominant Grasses**Spike grass (*Uniola latifolia*)Wild chess (*Bromus purgans*)

67. East-facing limestone bluffs along Huzzah Creek, two miles southeast of Davisville, Crawford County.

Dominant TreesNorthern red oak (*Quercus borealis* var. *maxima*)Chinquapin oak (*Quercus Muhlenbergii*)**Other Tree Associates**Sugar maple (*Acer saccharum* var. *glacum*)American elm (*Ulmus americana*)Linden (*Tilia glabra*)Blue ash (*Fraxinus quadrangulata*)White ash (*Fraxinus americana*)Red mulberry (*Morus rubra*)Black walnut (*Juglans nigra*)Sour gum (*Nyssa sylvatica* var. *caroliniana*)Bitternut hickory (*Carya cordiformis*)Shagbark hickory (*Carya ovata*)**Dominant Understory**Bladdernut (*Staphylea trifolia*)**Other Understory Associates**Spicebush (*Benzoin aestivale*)Black haw (*Viburnum rufidulum*)Sassafras (*Sassafras albidum* var. *molle*)Pawpaw (*Asimina triloba*)Burning bush (*Euonymus atropurpureus*)Redbud (*Cercis canadensis*)Flowering dogwood (*Cornus florida*)Rough-leaved dogwood (*Cornus asperifolia*)Persimmon (*Diospyros virginiana*)**Dominant Herbaceous Non-Grass Plants**Bristly greenbrier (*Smilax hispida*)Wild yam (*Dioscorea quaternata*)Maidenhair fern (*Adiantum pedatum*)Leafcup (*Polymnia canadensis*)

68. Wooded talus at base of east-facing limestone bluff, "Log-slide Bluff," along White River, sec. 22-27, T. 22 N., R. 23 W., two miles west of Marmaros, Stone County.

Dominant Trees

Linden (<i>Tilia glabra</i>)	Bitternut hickory (<i>Carya cordiformis</i>)
Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)

Other Tree Associates

Butternut (<i>Juglans cinerea</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
Hackberry (<i>Celtis occidentalis</i> var. <i>canina</i>)	Yellow-wood (<i>Cladrastis lutea</i>)

Dominant Understory

Bladdernut (<i>Staphylea trifolia</i>)	Pawpaw (<i>Asimina triloba</i>)
Ironwood (<i>Carpinus caroliniana</i>)	

Understory Associate

Spicebush (*Benzoin aestivale*)

Dominant Herbaceous Non-Grass Plant

Leafcup (*Polymnia canadensis*)

Other Herbaceous Non-Grass Plant Associates

Pale touch-me-not (<i>Impatiens pallida</i>)	Enchanter's nightshade (<i>Circaea latifolia</i>)
Waterleaf (<i>Hydrophyllum appendiculatum</i>)	Wild ginger (<i>Asarum canadense</i> var. <i>acuminatum</i>)
Yellow violet (<i>Viola eriocarpa</i> var. <i>leiocarpa</i>)	Celandine poppy (<i>Stylophorum diphyllum</i>)
May-apple (<i>Podophyllum peltatum</i>)	
Moonseed (<i>Menispermum canadense</i>)	

69. Rich, wooded, north-facing, limestone slopes along spring branch tributary to Swan Creek, sec. 34, T. 26 N., R. 19 W., four miles southeast of Chadwick, Christian County.

Dominant Trees

Black maple (<i>Acer nigrum</i>)	Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)
Chinquapin oak (<i>Quercus Muhlenbergii</i>)	

Other Tree Associates

Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Bur oak (<i>Quercus macrocarpa</i>)
Blue ash (<i>Fraxinus quadrangulata</i>)	American elm (<i>Ulmus americana</i>)

Dominant Understory

Pawpaw (<i>Asimina triloba</i>)	Spicebush (<i>Benzoin aestivale</i>)
Bladdernut (<i>Staphylea trifolia</i>)	

Understory Associate

Arrow-wood (*Viburnum molle*)

Dominant Herbaceous Non-Grass Plants

Waterleaf (<i>Hydrophyllum appendiculatum</i>)	Liverleaf (<i>Hepatica americana</i>)
Leafcup (<i>Polymnia canadensis</i>)	Moonseed (<i>Menispermum canadense</i>)

Other Herbaceous Non-Grass Plant AssociatesCup-seed (*Calycocarpum Lyoni*) False spikenard (*Smilacina racemosa*)**Dominant Grasses**Wild chess (*Bromus purgans*) Bottle brush (*Hystrix patula*)
Fescue grass (*Festuca obtusa*) *Diarina festucoides*

70. Northwest-facing wooded slopes along Swan Creek, sec. 34, T. 26 N., R. 19 W., four miles southeast of Chadwick, Christian County.

Dominant TreesBlack maple (*Acer nigrum*) Linden (*Tilia glabra*)
Sugar maple (*Acer saccharum* var. *glaucum*) Bitternut hickory (*Carya cordiformis*)**Other Tree Associates**White ash (*Frazinus americana*) Slippery elm (*Ulmus fulva*)**Dominant Understory**Arrow-wood (*Viburnum molle*) Bladdernut (*Staphylea trifolia*)
Pawpaw (*Asimina triloba*) Spicebush (*Benzoin aestivale*)
Ironwood (*Carpinus caroliniana*)**Understory Associate**Leatherwood (*Dirca palustris*)**Dominant Herbaceous Non-Grass Plants**Liverleaf (*Hepatica acutiloba*) Black snakeroot (*Cimicifuga racemosa*)
Early meadow rue (*Thalictrum dioicum*) Leafcup (*Polymnia canadensis*)**Other Herbaceous Non-Grass Plant Associates**Liverleaf (*Hepatica americana*) Indian turnip (*Arisaema triphyllum*)
Joe-Pye weed (*Eupatorium purpureum*) Wood's hellebore (*Veratrum Woodii*)

71. North-facing limestone slopes along valley bordering Stinson Creek, near Ballinger Springs, sec. 1, T. 46 N., R. 9 W., two miles northeast of Hams Prairie, Callaway County.

Dominant TreesSugar maple (*Acer saccharum* var. *glaucum*) Linden (*Tilia glabra*)
Black maple (*Acer nigrum*)**Other Tree Associates**Butternut (*Juglans cinerea*) Kentucky coffee tree (*Gymnocladus dioica*)
Bitternut hickory (*Carya cordiformis*)**Dominant Understory**Pawpaw (*Asimina triloba*) Ironwood (*Carpinus caroliniana*)
Alternate-leaved dogwood (*Cornus alternifolia*) Bladdernut (*Staphylea trifolia*)**Understory Associate**Arrow-wood (*Viburnum molle*)**Dominant Herbaceous Non-Grass Plant**Woollen breeches (*Hydrophyllum appendiculatum*)

Other Herbaceous Non-Grass Plants

- | | |
|--|--|
| Celandine poppy (<i>Stylophorum diphyllum</i>) | White avens (<i>Geum canadense</i> var. <i>camporum</i>) |
| Goldenrod (<i>Solidago latifolia</i>) | Wild geranium (<i>Geranium maculatum</i>) |
| Clearweed (<i>Pilea pumila</i> var. <i>Deamii</i>) | Bloodroot (<i>Sanguinaria canadensis</i>) |
| Narrow-leaved spleenwort (<i>Athyrium pycnocarpon</i>) | Spiderwort (<i>Tradescantia subaspera</i>) |
| Leafcup (<i>Polymnia canadensis</i>) | Maidenhair fern (<i>Adiantum pedatum</i>) |

72. North-facing limestone bluffs with wooded talus slopes below, along Osage River, sec. 2, T. 40 N., R. 13 W., west of Capps, Miller County.

Dominant Trees

- | | |
|---|--|
| Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>) | Chinquapin oak (<i>Quercus Muhlenbergii</i>) |
|---|--|

Other Tree Associates

- | | |
|--------------------------------------|---|
| Linden (<i>Tilia glabra</i>) | Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>) |
| Butternut (<i>Juglans cinerea</i>) | |
| White oak (<i>Quercus alba</i>) | |

Dominant Understory

- | | |
|---|---|
| American hornbeam (<i>Carpinus caroliniana</i>) | Bladdernut (<i>Staphylea trifolia</i>) |
| | Flowering dogwood (<i>Cornus florida</i>) |

Other Understory Associates

- | | |
|--|-----------------------------------|
| Benzoin (<i>Benzoin aestivale</i>) | Pawpaw (<i>Asimina triloba</i>) |
| Hydrangea (<i>Hydrangea arborescens</i>) | |

Dominant Herbaceous Non-Grass Plant

Goldenrod (*Solidago latifolia*)

73. North-facing limestone bluffs along Little Niangua River, sec. 5, T. 38 N., R. 18 W., two and one-half miles south of Barnumtown, Camden County.

Dominant Trees

- | | |
|---|--|
| Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>) | Bitternut hickory (<i>Carya cordiformis</i>)—at base |
| Black maple (<i>Acer nigrum</i>) | |

Other Tree Associates

- | | |
|--------------------------------------|---|
| Linden (<i>Tilia glabra</i>) | Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>) |
| Butternut (<i>Juglans cinerea</i>) | |

Dominant Understory

- | | |
|--|---|
| Bladdernut (<i>Staphylea trifolia</i>) | American hornbeam (<i>Carpinus caroliniana</i>) |
| Benzoin (<i>Benzoin aestivale</i>) | |
| Pawpaw (<i>Asimina triloba</i>) | |

Dominant Herbaceous Non-Grass Plants

- | | |
|--|--|
| Pale touch-me-not (<i>Impatiens pallida</i>) | Leafcup (<i>Polymnia canadensis</i>) |
|--|--|

Other Herbaceous Non-Grass Plants

- | | |
|---|--|
| Woollen breeches (<i>Hydrophyllum appendiculatum</i>) | Narrow-leaved spleenwort (<i>Athyrium pycnocarpon</i>) |
|---|--|

74. West-facing, wooded, limestone slope along Brushy Creek, sec. 8, T. 27 N., R. 3 E., six miles north of Ellsinore, Carter County.

Dominant Tree

Sugar maple (*Acer saccharum* var. *glaucom*)

Other Tree Associates

Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	White ash (<i>Fraxinus americana</i>)
White oak (<i>Quercus alba</i>)	Linden (<i>Tilia glabra</i>)
Chinquapin oak (<i>Quercus Muhlenbergii</i>)	Mulberry (<i>Morus rubra</i>)
Bitternut hickory (<i>Carya cordiformis</i>)	Slippery elm (<i>Ulmus fulva</i>)
Shagbark hickory (<i>Carya ovata</i>)	Winged elm (<i>Ulmus alata</i>)

Chief Understory

Bladdernut (<i>Staphylea trifolia</i>)	Flowering dogwood (<i>Cornus florida</i>)
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Other Understory Associates

Possum haw (<i>Ilex decidua</i>)	Hop hornbeam (<i>Ostrya virginiana</i>)
Chittim-wood (<i>Bumelia lanuginosa</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
Hackberry (<i>Celtis laevigata</i> var. <i>texana</i>)	Eastern witch hazel (<i>Hamamelis virginiana</i>)
Wild plum (<i>Prunus americana</i>)	Black haw (<i>Viburnum rufidulum</i>)
American hornbeam (<i>Carpinus caroliniana</i>)	Redbud (<i>Cercis canadensis</i>)
Hydrangea (<i>Hydrangea arborescens</i>)	

Dominant Grass-like Plant

Carex eburnea

Other Grass or Grass-like Associates

Wild chess (<i>Bromus purgans</i>)	Fescue grass (<i>Festuca paradoxa</i>)
Indian grass (<i>Sorghastrum nutans</i>)	Blue-stem grass (<i>Andropogon scoparius</i>)

75. Lower portion of northeast-facing limestone slopes along St. Francis River, just west of Greenville, Wayne County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucom</i>)	Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)
Chinquapin oak (<i>Quercus Muhlenbergii</i>)	

Dominant Understory

Black haw (<i>Viburnum rufidulum</i>)	Hazelnut (<i>Corylus americana</i>)
White ash (<i>Fraxinus americana</i>)	Redbud (<i>Cercis canadensis</i>)
Pawpaw (<i>Asimina triloba</i>)	Ironwood (<i>Carpinus caroliniana</i>)
Indian cherry (<i>Rhamnus caroliniana</i>)	Hop tree (<i>Ptelea trifoliata</i>)

Dominant Herbaceous Non-Grass Plants

Liverleaf (<i>Hepatica acutiloba</i>)	Early meadow rue (<i>Thalictrum dioicum</i>)
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Dominant Grasses

Fescue grass (<i>Festuca obtusa</i>)	Sphenopholis (<i>Sphenopholis intermedia</i>)
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76. North-facing, wooded, limestone slopes along Brushy Creek, sec. 8, T. 27 N., R. 3 E., six miles north of Ellsinore, Carter County.

Dominant Trees

Sugar maple (*Acer saccharum* var. *glabrum*) Northern red oak (*Quercus borealis* var. *maxima*)

Other Tree Associates

White oak (<i>Quercus alba</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
White ash (<i>Fraxinus americana</i>)	Red maple (<i>Acer rubrum</i>)
Bitternut hickory (<i>Carya cordiformis</i>)	Sycamore (<i>Platanus occidentalis</i>)
Butternut (<i>Juglans cinerea</i>)	Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)
River birch (<i>Betula nigra</i>)	

Dominant Understory

Dogwood (*Cornus florida*) Ironwood (*Carpinus caroliniana*)

Other Understory Associates

Smooth alder (*Alnus rugosa*) Redbud (*Cercis canadensis*)
Buck brush (*Symphoricarpos orbicu-
latus*) Button-bush (*Cephalanthus occidentalis*)
Black haw (*Viburnum rufidulum*) Spicebush (*Benzoin aestivale*)
Shadbush, serviceberry (*Amelanchier
canadensis*) Hazelnut (*Corylus americana*)
American bladdernut (*Staphylea tri-
folia*) Hop hornbeam (*Ostrya virginiana*)
Fragrant sumac (*Rhus aromatica*) Ozark witch hazel (*Hamamelis vernalis*)
 Ward's willow (*Salix longipes* var.
 Wardii)
 Hydrangea (*Hydrangea arborescens*)

Dominant Herbaceous Non-Grass Plant

Liverleaf (*Hepatica acutiloba*)

Dominant Grasses

Thin grass (*Agrostis perennans*) Fowl meadow grass (*Glyceria striata*)

77. Rich, low woods and adjacent lower limestone slopes along spring branch tributary to Current River, sec. 34, T. 25 N., R. 1 E., six miles northeast of Bennett, Ripley County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glabrum</i>)	Red mulberry (<i>Morus rubra</i>)
Red maple (<i>Acer rubrum</i>)	Black walnut (<i>Juglans nigra</i>)
Chinquapin oak (<i>Quercus Muhlenbergii</i>)	Linden (<i>Tilia glabra</i>)
Bitternut hickory (<i>Carya cordiformis</i>)	White ash (<i>Fraxinus americana</i>)
Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)	Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)
	American elm (<i>Ulmus americana</i>)

Dominant Understory

Spicebush (*Benzoin aestivale*) Ironwood (*Carpinus caroliniana*)
Hazelnut (*Corylus americana*) Pawpaw (*Asimina triloba*)
Redbud (*Cercis canadensis*) Bladdernut (*Staphylea trifolia*)

78. North-facing, wooded, limestone slopes along Big Creek, sec. 18, T. 31 N., R. 2 W., three miles northeast of Rat, Shannon County.

Dominant Trees

Sugar maple (*Acer saccharum* var. *glabrum*) American linden (*Tilia glabra*)
Butternut (*Juglans cinerea*)

Dominant Understory

- | | |
|---|--|
| Eastern witch hazel (<i>Hamamelis virginiana</i>) | Flowering dogwood (<i>Cornus florida</i>) |
| Spicebush (<i>Benzoin aestivale</i>) | Running strawberry-bush (<i>Euonymus obovatus</i>) |
| Ohio buckeye (<i>Aesculus glabra</i> f. <i>pallida</i>) | Bristly greenbrier (<i>Smilax hispida</i>) |
| Bladdernut (<i>Staphylea trifolia</i>) | |

Dominant Herbaceous Non-Grass PlantWood's hellebore (*Veratrum Woodii*)**Dominant Grasses and Grass-like Plants***Brachyelytrum erectum*Sedge (*Carex eburnea*)

79. North-facing, wooded, limestone slopes along Bee Fork of Black River, sec. 23, T. 32 N., R. 1 W., four miles northwest of Centerville, Reynolds County.

Dominant Trees

- | | |
|---|--|
| Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>) | Butternut (<i>Juglans cinerea</i>) |
| Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>) | Red mulberry (<i>Morus rubra</i>) |
| Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>) | American elm (<i>Ulmus americana</i>) |
| | Linden (<i>Tilia glabra</i>) |
| | Bitternut hickory (<i>Carya cordiformis</i>) |

Dominant Understory of Upper Portion

- | | |
|---|---|
| Eastern witch hazel (<i>Hamamelis virginiana</i>) | Flowering dogwood (<i>Cornus florida</i>) |
| Hop hornbeam (<i>Ostrya virginiana</i>) | Juneberry, serviceberry (<i>Amelanchier canadensis</i>) |
| Redbud (<i>Cercis canadensis</i>) | |

Dominant Understory of Lower Portion

- | | |
|---|--|
| Leatherwood (<i>Dirca palustris</i>) | Spicebush (<i>Benzoin aestivale</i>) |
| Flowering dogwood (<i>Cornus florida</i>) | |

Dominant Herbaceous Non-Grass PlantLiverleaf (*Hepatica acutiloba*)

80. East-facing limestone slopes along Brushy Creek, sec. 24, T. 33 N., R. 1 W., one mile north of Moses Store, Reynolds County.

Dominant Trees

- | | |
|---|---|
| Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>) | Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>) |
| Linden (<i>Tilia glabra</i>) | |

Tree AssociateBlack cherry (*Prunus serotina*)**Dominant Understory**

- | | |
|---|---|
| Eastern witch hazel (<i>Hamamelis virginiana</i>) | Flowering dogwood (<i>Cornus florida</i>) |
|---|---|

Other Understory Associates

- | | |
|--|---|
| Ironwood (<i>Carpinus caroliniana</i>) | Juneberry, serviceberry (<i>Amelanchier canadensis</i>) |
| Spicebush (<i>Benzoin aestivale</i>) | |
| Leatherwood (<i>Dirca palustris</i>) | Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>) |

Dominant Herbaceous Non-Grass Plants

- | | |
|--|--|
| Early meadow rue (<i>Thalictrum dioicum</i>) | Wild ginger (<i>Asarum canadense</i> var. <i>reflexum</i>) |
| Liverleaf (<i>Hepatica acutiloba</i>) | |
| Black cohosh (<i>Cimicifuga racemosa</i>) | |

81. West-facing, cherty limestone slopes along Otter Creek, sec. 18, T. 27 N., R. 6 E., near Taskee, Wayne County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glacum</i>)	Black walnut (<i>Juglans nigra</i>)
Winged elm (<i>Ulmus alata</i>)	White ash (<i>Fraxinus americana</i>)
White oak (<i>Quercus alba</i>)	Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Mockernut hickory (<i>Carya tomentosa</i>)

Dominant Understory

Dogwood (<i>Cornus florida</i>)	Hop hornbeam (<i>Ostrya virginiana</i>)
Fragrant sumac (<i>Rhus aromatica</i>)	Redbud (<i>Cercis canadensis</i>)
Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)	Shadbush (<i>Amelanchier canadensis</i>)
American bladdernut (<i>Staphylea trifolia</i>)	Indian cherry (<i>Rhamnus caroliniana</i>)
	Ironwood (<i>Carpinus caroliniana</i>)

82. Base of rich, low, wooded slopes just above alluvial woods along Gasconade River, east of Mossy Spring, sec. 2, T. 36 N., R. 11 W., seven miles northeast of Waynesville, Pulaski County.

Dominant Trees

Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Bitternut hickory (<i>Carya cordiformis</i>)
White oak (<i>Quercus alba</i> f. <i>latiloba</i>)	Linden (<i>Tilia glabra</i>)

Other Tree Associates

Hackberry (<i>Celtis occidentalis</i> var. <i>canina</i>)	Slippery elm (<i>Ulmus fulva</i>)
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Dominant Understory

Ironwood (<i>Carpinus caroliniana</i>)	Pawpaw (<i>Asimina triloba</i>)
Burning bush (<i>Euonymus atropurpureus</i>)	

Other Understory Associates

Moonseed (<i>Menispermum canadense</i>)	Sassafras (<i>Sassafras albidum</i>)
Buck brush (<i>Symphoricarpos orbiculatus</i>)	Virginia creeper (<i>Parthenocissus quinquefolia</i>)

Dominant Herbaceous Non-Grass Plants

Pale touch-me-not (<i>Impatiens pallida</i>)	White violet (<i>Viola striata</i>)
White crown-beard (<i>Verbesina virginica</i>)	Wild ginger (<i>Asarum canadense</i> var. <i>acuminatum</i>)
Clearweed (<i>Pilea pumila</i> var. <i>Deamii</i>)	
Pokeweed (<i>Phytolacca americana</i>)	

Other Herbaceous Non-Grass Plant Associates

Blephilia (<i>Blephilia hirsuta</i>)	Skullcap (<i>Scutellaria ovata</i>)
Wood nettle (<i>Laportea canadensis</i>)	Joe-Pye weed (<i>Eupatorium purpureum</i>)
Yellow violet (<i>Viola eriocarpa</i> var. <i>leiocarpa</i>)	Wild yam (<i>Dioscorea villosa</i>)
Fragile fern (<i>Cystopteris fragilis</i> var. <i>protrusa</i>)	Enchanter's nightshade (<i>Circaea latifolia</i>)
Hog-peanut (<i>Amphicarpa bracteata</i>)	Wild blue phlox (<i>Phlox divaricata</i> var. <i>Laphamii</i>)
Fragrant bedstraw (<i>Galium triflorum</i>)	Vervain (<i>Verbena urticaefolia</i>)
Bloodroot (<i>Sanguinaria canadensis</i>)	

83. East-facing, cherty, limestone slopes along Ottery Creek, sec. 34, T. 34 N., R. 1 E., two miles northeast of Edgehill, Iron County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Bitternut hickory (<i>Carya cordiformis</i>)
Shagbark hickory (<i>Carya ovata</i>)	White ash (<i>Fraxinus americana</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Linden (<i>Tilia glabra</i>)
	White oak (<i>Quercus alba</i>)
	Butternut (<i>Juglans cinerea</i>)

Dominant Understory

Flowering dogwood (*Cornus florida*)

84. West-facing, porphyritic, trachyte slopes along Ottery Creek, sec. 26, T. 34 N., R. 1 E., three miles northeast of Edgehill, Iron County.

Dominant Tree

Winged elm (*Ulmus alata*)

Other Tree Associates

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	White oak (<i>Quercus alba</i>)
	Shagbark hickory (<i>Carya ovata</i>)

Dominant Understory

Hop hornbeam (<i>Ostrya virginiana</i>)	Hackberry (<i>Celtis laevigata</i> var. <i>texana</i>)
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85. Limestone bluffs at mouth of spring branch of Pulltight Spring, Shannon County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
Red cedar (<i>Juniperus virginiana</i>)	Schneck's red oak (<i>Quercus Shumardii</i> var. <i>Schneckii</i>)
Chittim-wood (<i>Bumelia lanuginosa</i>)	Persimmon (<i>Diospyros virginiana</i>)

86. Rich, east-facing slopes at base of limestone bluffs along King's River, south of Prentiss Ford, sec. 24, T. 21 N., R. 25 W., five miles south of Viola, Barry County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)
Chinquapin oak (<i>Quercus Muhlenbergii</i>)	

Dominant Understory

Black locust (<i>Robinia Pseudo-acacia</i>)	Spicebush (<i>Benzoin aestivale</i>)
Pawpaw (<i>Asimina triloba</i>)	Redbud (<i>Cercis canadensis</i>)

87. Limestone draw between upper part of bald knob in Hercules Game Refuge, sec. 10-11, T. 24 N., R. 18 W., two miles southwest of Hercules, Taney County.

Dominant Trees

- Sugar maple (*Acer saccharum* var. *glaucum*) Schneck's red oak (*Quercus Shumardii* var. *Schneckii*)
 Smoke tree (*Cotinus americanus*)

Dominant Understory

- Flowering dogwood (*Cornus florida*) Possum haw (*Ilex decidua*)
 Swamp dogwood (*Cornus obliqua*) Ninebark (*Physocarpus opulifolius* var. *intermedius*)
 Rough-leaved dogwood (*Cornus asperifolia*) *Andrachne phyllanthoides*

Other Understory Associates

- Indian cherry (*Rhamnus caroliniana*) Fringe tree (*Chionanthus virginica*)

88. North-facing, wooded, limestone slopes along Pomme de Terre River, three miles northeast of Elkland, Hickory County.

Dominant Trees

- Sugar maple (*Acer saccharum* var. *glaucum*) Northern red oak (*Quercus borealis* var. *maxima*)

Dominant Understory

- Bladdernut (*Staphylea trifolia*) Pawpaw (*Asimina triloba*)

Other Understory Associates

- Prickly ash (*Zanthoxylum americanum*) Flowering dogwood (*Cornus florida*)
 Bittersweet (*Celastrus scandens*) Burning bush (*Euonymus atropurpureus*)

Dominant Herbaceous Non-Grass Plants

- Tick trefoil (*Desmodium acuminatum*) Tall bellflower (*Campanula americana*)
 Joe-Pye weed (*Eupatorium purpureum*) Lopseed (*Phryma leptostachya*)
 Agrimony (*Agrimonia rostellata*)

Dominant Grass

Brachyelytrum erectum

89. Northeast-facing, wooded, limestone slopes at base of bluffs along Gasconade River, sec. 8, T. 36 N., R. 12 W., five miles northwest of Waynesville, Pulaski County.

Dominant Trees

- Black maple (*Acer nigrum*) Linden (*Tilia glabra*)
 Sugar maple (*Acer saccharum* var. *glaucum*) Northern red oak (*Quercus borealis* var. *maxima*)

Dominant Understory

- Alternate-leaved dogwood (*Cornus alternifolia*) Bladdernut (*Staphylea trifolia*)

Other Understory Associates

- Arrow-wood (*Viburnum molle*) Dogwood (*Cornus florida*)
 Ironwood (*Carpinus caroliniana*)

90. North-facing, shaley, limestone slopes along Deepwater Creek, sec. 20, T. 40 N., R. 29 W., one and one-half miles southwest of Spruce, Bates County.

98. East-facing limestone slopes along Fourche à Renault Creek, sec. 15, T. 37 N., R. 1 E., one and one-half miles north of Shirley, Washington County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Linden (<i>Tilia glabra</i>)
	Chinquapin oak (<i>Quercus Muhlenbergii</i>)

Other Tree Associates

Slippery elm (<i>Ulmus fulva</i>)	Red mulberry (<i>Morus rubra</i>)
Butternut (<i>Juglans cinerea</i>)	Winged elm (<i>Ulmus alata</i>)
Red cedar (<i>Juniperus virginiana</i>)	

Dominant Understory

Hop hornbeam (<i>Ostrya virginiana</i>)	Ironwood (<i>Carpinus caroliniana</i>)
Chittim-wood (<i>Bumelia lanuginosa</i>)	Redbud (<i>Cercis canadensis</i>)

99. Intermediate zone of east-facing limestone slopes between upper, drier, cedar-clad slopes and lower, richer soil slopes along Fourche à Renault Creek, sec. 15, T. 37 N., R. 1 E., one and one-half miles north of Shirley, Washington County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Linden (<i>Tilia glabra</i>)
Schneck's red oak (<i>Quercus Shumardii</i> var. <i>Schneckii</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
	White ash (<i>Fraxinus americana</i>)
	Winged elm (<i>Ulmus alata</i>)

Dominant Understory

Rough-leaved dogwood (<i>Cornus asperifolia</i>)	Buck brush (<i>Symphoricarpos orbiculatus</i>)
Hop hornbeam (<i>Ostrya virginiana</i>)	Ninebark (<i>Physocarpus opulifolius</i> var. <i>intermedius</i>)
Redbud (<i>Cercis canadensis</i>)	
Smooth sumac (<i>Rhus glabra</i>)	

100. Upland slopes following along gravel bar of Little Fourche à Renault Creek, sec. 2, T. 37 N., R. 1 E., two miles southeast of Floyd, Washington County.

Dominant Trees

White oak (<i>Quercus alba</i>)	Mockernut hickory (<i>Carya tomentosa</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Bitternut hickory (<i>Carya cordiformis</i>)
	Black walnut (<i>Juglans nigra</i>)

Dominant Understory

Redbud (*Cercis canadensis*)

101. North-facing, wooded, limestone slopes along Big Creek, sec. 18, T. 31 N., R. 2 W., three miles northeast of Rat, Shannon County.

Dominant Trees

Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Linden (<i>Tilia glabra</i>)
	Butternut (<i>Juglans cinerea</i>)

Dominant Understory

Eastern witch hazel (<i>Hamamelis virginiana</i>)	Running strawberry-bush (<i>Euonymus obovatus</i>)
Spicebush (<i>Benzoin aestivale</i>)	Flowering dogwood (<i>Cornus florida</i>)
Ohio buckeye (<i>Aesculus glabra</i> f. <i>pallida</i>)	Bladdernut (<i>Staphylea trifolia</i>)

102. Acid, wooded valley floor along headwaters of branch south of Enough, Iron County.

Dominant Trees

White oak (<i>Quercus alba</i>)	Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)
Black oak (<i>Quercus velutina</i>)	

Other Tree Associates

Red maple (<i>Acer rubrum</i>)	Honey locust (<i>Gleditsia triacanthos</i>)
Sycamore (<i>Platanus occidentalis</i>)	Winged elm (<i>Ulmus alata</i>)
Butternut (<i>Juglans cinerea</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
Mockernut hickory (<i>Carya tomentosa</i>)	Bitternut hickory (<i>Carya cordiformis</i>)

Dominant Understory

Smooth alder (<i>Alnus rugosa</i>)	Hazelnut (<i>Corylus americana</i>)
Ironwood (<i>Carpinus caroliniana</i>)	Black haw (<i>Viburnum rufidulum</i>)
Ozark witch hazel (<i>Hamamelis vernalis</i>)	Hop hornbeam (<i>Ostrya virginiana</i>)
Flowering dogwood (<i>Cornus florida</i>)	Bristly greenbrier (<i>Smilax hispida</i>)
Juneberry, serviceberry (<i>Amelanchier canadensis</i>)	Ward's willow (<i>Salix longipes</i> var. <i>Wardii</i>)
Redbud (<i>Cercis canadensis</i>)	

103. Valley floor of shallow ravine along headwaters of Sinking Creek, sec. 10, T. 32 N., R. 3 W., three miles northwest of Bunker, in Dent County.

Dominant Trees

Sycamore (<i>Platanus occidentalis</i>)	Bitternut hickory (<i>Carya cordiformis</i>)
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Other Tree Associates

Slippery elm (<i>Ulmus fulva</i>)	Black gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Shumard's red oak (<i>Quercus shumardii</i>)
White oak (<i>Quercus alba</i>)	

Dominant Understory

Buck brush (<i>Symphoricarpos orbiculatus</i>)	Hazelnut (<i>Corylus americanus</i>)
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Other Understory Associates

Redbud (<i>Cercis canadensis</i>)	Smooth alder (<i>Alnus rugosa</i>)
Ironwood (<i>Carpinus caroliniana</i>)	Swamp dogwood (<i>Cornus obliqua</i>)
Flowering dogwood (<i>Cornus florida</i>)	Ward's willow (<i>Salix longipes</i> var. <i>Wardii</i>)
Pawpaw (<i>Asimina triloba</i>)	
Black haw (<i>Viburnum rufidulum</i>)	

104. Sandy, alluvial woods along Marble Creek opposite limestone bluffs, sec. 21, T. 32 N., R. 5 E., two and one-half miles southwest of French Mills, Madison County.

Dominant Trees

Red cedar (<i>Juniperus virginiana</i>)	Red maple (<i>Acer rubrum</i>)
Southern yellow pine (<i>Pinus echinata</i>)	Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)
Sugar maple (<i>Acer saccharum</i> var. <i>glaucum</i>)	Chinquapin oak (<i>Quercus Muhlenbergii</i>)
White oak (<i>Quercus alba</i>)	

Dominant Understory

Leatherwood (<i>Dirca palustris</i>)	Indian cherry (<i>Rhamnus caroliniana</i> var. <i>mollis</i>)
Chittim-wood (<i>Bumelia lanuginosa</i>)	
Ironwood (<i>Carpinus caroliniana</i>)	

III. QUERCUS-CARYA ASSOCIATION**(2) Quercus marilandica-Quercus stellata Associates**

105. Upland, level, wooded ridge top between highway No. 32 and Dillard, Crawford County.

Dominant Trees

Post oak (<i>Quercus stellata</i>)	Black jack oak (<i>Quercus marilandica</i>)
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Other Tree Associates

White oak (<i>Quercus alba</i>)	Black oak (<i>Quercus velutina</i>)
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106. West-facing, upland, granite glade at Granite Bend, sec. 10, T. 27 N., R. 4 E., five miles northwest of Williamsville, Wayne County.

Dominant Trees

Post oak (<i>Quercus stellata</i>)	Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)
Black jack oak (<i>Quercus marilandica</i>)	
Winged elm (<i>Ulmus alata</i>)	

Dominant Herbaceous Non-Grass Plants

<i>Crotonopsis elliptica</i>	Rock pink (<i>Talinum calycinum</i>)
False aloe (<i>Agave virginica</i>)	

Dominant Grasses and Grass-like Plants

Wild oats grass (<i>Danthonia spicata</i>)	Slender fescue grass (<i>Festuca octoflora</i>)
Panic grass (<i>Panicum linearifolium</i>)	<i>Cyperus filiculmis</i> var. <i>macilentus</i>

(3) Quercus velutina-Carya Buckleyi var. arkansana Associates

107. Upper valley wooded portion of Stilwell Hollow, in Low Gap Game Refuge, sec. 12, T. 32 N., R. 1 E., southeast of Black U. S. Lookout, four miles southwest of Black, Reynolds County.

Dominant Trees

Mockernut hickory (<i>Carya tomentosa</i>)	Black oak (<i>Quercus velutina</i>)
White oak (<i>Quercus alba</i>)	Shagbark hickory (<i>Carya ovata</i>)

Dominant Understory

Fragrant sumac (*Rhus aromatica*)

108. Upland oak-hickory woods in grazing plot southwest of Bunker CCC camp F-7, sec. 3, T. 33 N., R. 3 W., five miles northwest of Bunker, in Dent County.

Dominant Trees

White oak (<i>Quercus alba</i>)	Black gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)
Post oak (<i>Quercus stellata</i>)	Mockernut hickory (<i>Carya tomentosa</i>)
Black oak (<i>Quercus velutina</i>)	Bitternut hickory (<i>Carya cordiformis</i>)
Black jack oak (<i>Quercus marilandica</i>)	Shagbark hickory (<i>Carya ovata</i>)
Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)	

Dominant Understory

Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>)	Smooth sumac (<i>Rhus glabra</i>)
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Dominant Grasses and Grass-like Plants

Wild oats grass (<i>Danthonia spicata</i>)	Panic grass (<i>Panicum dichotomum</i>)
Panic grass (<i>Panicum lanuginosum</i> var. <i>fasciculatum</i>)	Panic grass (<i>Panicum lanuginosum</i> var. <i>Lindheimeri</i>)
Panic grass (<i>Panicum linearifolium</i>)	Blue-stem (<i>Andropogon scoparius</i> var. <i>genuinus</i>)
Panic grass (<i>Panicum Boscii</i>)	
Sedge (<i>Carex cephalophora</i>)	

109. Level, upland, oak woods two miles northwest of Bunker CCC camp F-7, sec. 32, T. 33 N., R. 3 W., seven miles northwest of Bunker, in Dent County.

Dominant Trees

White oak (<i>Quercus alba</i>)	Black oak (<i>Quercus velutina</i>)
Post oak (<i>Quercus stellata</i>)	

Other Tree Associates

Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
Mockernut hickory (<i>Carya tomentosa</i>)	Shagbark hickory (<i>Carya ovata</i>)

Dominant Understory

Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>)	Hazelnut (<i>Corylus americana</i>)
	Flowering dogwood (<i>Cornus florida</i>)

Dominant Herbaceous Non-Grass Plant

Bush clover (*Lespedeza procumbens*)

Dominant Grasses and Grass-like Plants

Wild oats grass (<i>Danthonia spicata</i>)	Sedge (<i>Carex artilecta</i>)
Sedge (<i>Carex retroflexa</i>)	

110. Upland cherty woods, sec. 7, T. 25 N., R. 4 E., 10 miles southeast of Ellsinore, Carter County.

Dominant Trees

Scarlet oak (<i>Quercus coccinea</i>)	Post oak (<i>Quercus stellata</i>)
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Other Tree Associates

Black oak (<i>Quercus velutina</i>)	Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)
Black jack oak (<i>Quercus marilandica</i>)	
White oak (<i>Quercus alba</i>)	

Dominant Understory

Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*) Dwarf sumac (*Rhus Copallina*)

Understory Associate

Sassafras (*Sassafras albidum* var. *molle*)

Dominant Herbaceous Non-Grass Plants

Cinquefoil (*Potentilla simplex*) Bush clover (*Lespedeza procumbens*)
Goat's rue (*Tephrosia virginiana*) Pussy toes (*Antennaria plantaginifolia*)
Dittany (*Cunila origanoides*)

Herbaceous Non-Grass Associate

Forked chickweed (*Paronychia fastigiata* var. *typica*)

Dominant Grasses and Grass-like Plants

Sedge (*Carex hirsutella*) Wild oats grass (*Danthonia spicata*)

Grass Associate

Hair grass (*Agrostis hyemalis*)

111. Upland oak-hickory woods, sec. 20 and 21, T. 26 N., R. 7 E., three miles north of Rombauer, Butler County.

Dominant Trees

Scarlet oak (*Quercus coccinea*) Black jack oak (*Quercus marilandica*)
Black oak (*Quercus velutina*) Shagbark hickory (*Carya ovata*)
Post oak (*Quercus stellata*) Mockernut hickory (*Carya Buckleyi* var. *arkansana*)
Southern red oak (*Quercus falcata*)
Winged elm (*Ulmus alata*)

Dominant Understory

Fragrant sumac (*Rhus aromatica*) Sassafras (*Sassafras albidum* var. *molle*)
Dwarf sumac (*Rhus Copallina*)

Dominant Herbaceous Non-Grass Plants

Pussy toes (*Antennaria plantaginifolia*) Dittany (*Cunila origanoides*)
Cinquefoil (*Potentilla simplex*) Pinweed (*Lechea villosa*)
Goat's rue (*Tephrosia virginiana*) Bush clover (*Lespedeza repens*)
Pencil flower (*Stylosanthes biflora* var. *hispidissima*) Bergamot (*Monarda Bradburiana*)
Sensitive pea (*Cassia nictitans*) Bastard toadflax (*Comandra Richard-siana*)
Field goldenrod (*Solidago nemoralis*) Wild aster (*Aster patens*)
Bush clover (*Lespedeza procumbens*) Brown-eyed Susan (*Rudbeckia hirta*)
Tick trefoil (*Desmodium obtusum*)

Dominant Grasses and Grass-like Plants

Wild oats grass (*Danthonia spicata*) Sphenopholis (*Sphenopholis nitida*)
Beard grass (*Andropogon virginicus* var. *genuinus*) Paspalum (*Paspalum ciliatifolium* var. *Muhlenbergii*)

112. Upper, cherty slopes above limestone bluffs along Hazel Creek, sec. 14, T. 36 N., R. 1 W., one mile southwest of Palmer, Washington County.

Dominant Trees

Black oak (*Quercus velutina*) Northern red oak (*Quercus borealis* var. *maxima*)
White oak (*Quercus alba*)

Other Tree Associates

Black gum (*Nyssa sylvatica* var. *caroliniana*) Red maple (*Acer rubrum*)
Sassafras (*Sassafras albidum* var. *molle*)

113. West-facing, porphyritic trachyte slopes of Johnson Mountain, sec. 24, T. 35 N., R. 1 E., two miles south of Peoria, Iron County.

Dominant Trees

Ozark pignut hickory (*Carya Buckleyi* var. *arkansana*)
Post oak (*Quercus stellata*)

Dominant Understory

Fragrant sumac (*Rhus aromatica*)

Other Understory Associates

Flowering dogwood (*Cornus florida*) High-bush huckleberry (*Vaccinium
stamineum*)
Low-bush huckleberry (*Vaccinium vacil-
lans* var. *crinitum*)

114. Porphyritic trachyte outcrops on top of Johnson Mountain, sec. 24, T. 35 N., R. 1 E., two miles south of Peoria, Iron County.

Dominant Trees

Northern red oak (*Quercus borealis* var. *maxima*)
Post oak (*Quercus stellata*)

Dominant Understory

Winged sumac (*Rhus Copallina*) Fragrant sumac (*Rhus aromatica*)
Smooth sumac (*Rhus glabra*)

Dominant Grasses and Grass-like Plants

Big blue-stem (*Andropogon provincialis*) Panic grass (*Panicum lanuginosum* var. *fasciculatum*)
Fescue grass (*Festuca octoflora* var. *tenella*) Sedge (*Carex artitecta*)

115. Upland, level, oak woods near Dillard, Crawford County.

Dominant Trees

Scarlet oak (*Quercus coccinea*) Black jack oak (*Quercus marilandica*)

Other Tree Associates

White oak (*Quercus alba*) Black oak (*Quercus velutina*)

Dominant Understory

Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*)

116. Cherty upper slope south of Black, sec. 33, T. 33 N., R. 1 E., Reynolds County.

Dominant Trees

Black oak (<i>Quercus velutina</i>)	Mockernut hickory (<i>Carya tomentosa</i>)
White oak (<i>Quercus alba</i>)	Shagbark hickory (<i>Carya ovata</i>)
Scarlet oak (<i>Quercus coccinea</i>)	Red mulberry (<i>Morus rubra</i>)

Dominant Understory

Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>)	Smooth sumac (<i>Rhus glabra</i>)
Winged sumac (<i>Rhus Copallina</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
Fragrant sumac (<i>Rhus aromatica</i>)	Bristly greenbrier (<i>Smilax hispida</i>)
	Dewberry (<i>Rubus flagellaris</i>)

117. Upper south-facing portion near top of Little Pilot Knob, sec. 36, T. 38 N., R. 1 W., three miles northwest of Floyd, Washington County.

Dominant Trees

Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)	Shingle oak (<i>Quercus imbricaria</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Black oak (<i>Quercus velutina</i>)
	White oak (<i>Quercus alba</i>)
	Post oak (<i>Quercus stellata</i>)

Dominant Understory

High-bush huckleberry (<i>Vaccinium stamineum</i> var. <i>neglectum</i>)	Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>)
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118. Porphyritic trachyte soil on top of Little Pilot Knob, sec. 36, T. 38 N., R. 1 W., three miles northwest of Floyd, Washington County.

Dominant Trees

White oak (<i>Quercus alba</i>)	Post oak (<i>Quercus stellata</i>)
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Other Tree Associates

Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)	Shagbark hickory (<i>Carya ovata</i>)
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Dominant Understory

Smooth sumac (*Rhus glabra*)

119. Upper east-facing portion near top of Little Pilot Knob, sec. 36, T. 38 N., R. 1 W., three miles northwest of Floyd, Washington County.

Dominant Trees

Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	White oak (<i>Quercus alba</i>)
Shagbark hickory (<i>Carya ovata</i>)	Black oak (<i>Quercus velutina</i>)

Dominant Understory

Juneberry, serviceberry (<i>Amelanchier canadensis</i>)	New Jersey tea (<i>Ceanothus americanus</i>)
	Flowering dogwood (<i>Cornus florida</i>)

120. Upland oak-hickory woods, sec. 20 and 21, T. 26 N., R. 7 E., three miles northwest of Rombauer, Butler County.

Dominant Trees

Black oak (<i>Quercus velutina</i>)	Shingle oak (<i>Quercus imbricaria</i>)
White oak (<i>Quercus alba</i>)	Ozark hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)
Black jack oak (<i>Quercus marilandica</i>)	
Scarlet oak (<i>Quercus coccinea</i>)	Shagbark hickory (<i>Carya ovata</i>)

Dominant UnderstoryFarkleberry (*Vaccinium arboreum* var. *glaucescens*)

121. South-facing wooded slopes by headwaters of Meramec River along dry bed of river, sec. 14, T. 33 N., R. 4 W., two miles southeast of Max, Dent County.

Dominant Trees

Post oak (<i>Quercus stellata</i>)	Black jack oak (<i>Quercus marilandica</i>)
Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)	Shagbark hickory (<i>Carya ovata</i>)
	Mockernut hickory (<i>Carya tomentosa</i>)

122. North-facing wooded slopes by headwaters of Meramec River along dry bed of river, sec. 14, T. 33 N., R. 4 W., two miles southeast of Max, Dent County.

Dominant Trees

Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	White oak (<i>Quercus alba</i>)
	Black oak (<i>Quercus velutina</i>)

IV. QUERCUS-PINUS ECHINATA ASSOCIATION**(2b) Quercus marilandica-Quercus stellata-Pinus echinata Associates**

123. Woods off North Fork Hollow, near Cane Creek, sec. 8, T. 26 N., R. 4 E., six miles east of Ellsinore, south of Upalika, near Wayne County line, in Butler County.

Dominant TreeSouthern yellow pine (*Pinus echinata*)**Subdominant Trees**

Post oak (<i>Quercus stellata</i>)	Black jack oak (<i>Quercus marilandica</i>)
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Chief Understory

White oak (<i>Quercus alba</i> f. <i>latiloba</i>)	Ozark hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)
Fragrant sumac (<i>Rhus aromatica</i>)	Mockernut hickory (<i>Carya tomentosa</i>)
Winged sumac (<i>Rhus Copallina</i>)	Shingle oak (<i>Quercus imbricaria</i>)
Winged elm (<i>Ulmus alata</i>)	Shagbark hickory (<i>Carya ovata</i>)
Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>)	

Dominant Herbaceous Non-Grass Plants

Pussy toes (<i>Antennaria plantaginifolia</i>)	Bush clover (<i>Lespedeza repens</i>)
Bush clover (<i>Lespedeza procumbens</i>)	

Dominant GrassWild oats grass (*Danthonia spicata*)

123a. Pine stand on southeast-facing portion of porphyritic trachyte slopes of Little Pilot Knob, sec. 36, T. 38 N., R. 1 W., three miles northwest of Floyd, Washington County.

Dominant Tree

Southern yellow pine (*Pinus echinata*)

Tree Associate

Ozark pignut hickory (*Carya Buckleyi* var. *arkansana*)

Dominant Understory

Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*)

Dominant Herbaceous Non-Grass Plants

Dittany (*Cunila origanoides*)

Pussy toes (*Antennaria plantaginifolia*)

Aster (*Aster patens*)

Dominant Grasses and Grass-like Plants

Panic grass (*Panicum lanuginosum* var.

Sedge (*Carex artilecta*)

fasciculatum)

Wild oats grass (*Danthonia spicata*)

Sedge (*Carex hirsutella*)

(2c) **Mixed Oak-Hickory-Pine Associates**

124. Upper wooded ravine slopes of Stilwell Hollow, in Low Gap Game Refuge, sec. 12, T. 32 N., R. 1 E., southeast of Black U. S. Lookout, four miles southwest of Black, Reynolds County.

Dominant Trees

Black oak (*Quercus velutina*)

Scarlet oak (*Quercus coccinea*)

Other Tree Associates

Ozark pignut hickory (*Carya Buckleyi* var. *arkansana*)

Southern yellow pine (*Pinus echinata*)
Slippery elm (*Ulmus fulva*)

Dominant Grass

Wild chess (*Bromus purgans*)

125. Upland cherty ridge near Cornwall, Madison County.

Dominant Trees

Scarlet oak (*Quercus coccinea*)

White oak (*Quercus alba*)

Black oak (*Quercus velutina*)

Southern yellow pine (*Pinus echinata*)

Other Tree Associates

Post oak (*Quercus stellata*)

Ozark pignut hickory (*Carya Buckleyi* var. *arkansana*)

Mockernut hickory (*Carya tomentosa*)

126. Upper, cherty, west-facing slopes along Eleven Points River, sec. 11, T. 24 N., R. 3 W., one mile southeast of Turner's Mill, four miles southwest of Wilderness, Oregon County.

Dominant Trees

Southern yellow pine (*Pinus echinata*)

Mockernut hickory (*Carya tomentosa*)

White oak (*Quercus alba*)

Shagbark hickory (*Carya ovata*)

Black oak (*Quercus velutina*)

Black jack oak (*Quercus marilandica*)

Red maple (*Acer rubrum*)

Dominant Understory

Dogwood (*Cornus florida*)

Fragrant sumac (*Rhus aromatica*)

Dominant Herbaceous Non-Grass PlantsGoat's rue (*Tephrosia virginiana*)Dittany (*Cunila origanoides*)**Dominant Grass**Panic grass (*Panicum dichotomum*)

127. Upper, west-facing, cherty slopes, sec. 7, T. 25 N., R. 4 E.,
10 miles southeast of Ellsinore, Carter County.

Dominant TreeSouthern yellow pine (*Pinus echinata*)**Other Tree Associates**White oak (*Quercus alba*)Ozark pignut hickory (*Carya Buckleyi*Scarlet oak (*Quercus coccinea*)var. *arkansana*)Post oak (*Quercus stellata*)**Dominant Understory**Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*)**Dominant Herbaceous Non-Grass Plants**Dittany (*Cunila origanoides*)Goat's rue (*Tephrosia virginiana*)Bush clover (*Lespedeza hirta*)**Dominant Grasses and Grass-like Plants**Sedge (*Carex hirsutella*)Panic grass (*Panicum dichotomum*)

128. Upland, cherty, sandstone area, sec. 22, T. 26 N., R. 3 E.,
three miles south of Ellsinore, Carter County.

Dominant TreesSouthern yellow pine (*Pinus echinata*)Black jack oak (*Quercus marilandica*)Scarlet oak (*Quercus coccinea*)Ozark hickory (*Carya Buckleyi* var. *arkansana*)Spanish oak (*Quercus falcata*)Black oak (*Quercus velutina*)**Dominant Understory**Winged sumac (*Rhus Copallina*)Sassafras (*Sassafras albidum* var. *molle*)**Dominant Herbaceous Non-Grass Plants**Dittany (*Cunila origanoides*)Catgut, goat's rue (*Tephrosia virginiana*)Pussy toes (*Antennaria plantaginifolia*)Bush clover (*Lespedeza repens*)Bush clover (*Lespedeza procumbens*)

129. Cherty, steep exposures above bluffs along Huzzah Creek,
two miles southeast of Davisville, Crawford County.

Dominant TreesPost oak (*Quercus stellata*)Northern red oak (*Quercus borealis* var. *maxima*)Black oak (*Quercus velutina*)Winged elm (*Ulmus alata*)**Tree Associate**Southern yellow pine (*Pinus echinata*)

Dominant UnderstoryLow-bush huckleberry (*Vaccinium vacillans* var. *crinitum*)**Understory Associate**Hop hornbeam (*Ostrya virginiana*)

130. Cherty slopes along Stilwell Hollow, Low Gap Game Refuge, southeast of Black U. S. Lookout, sec. 12, T. 32 N., R. 1 E., four miles southwest of Black, Reynolds County.

Dominant TreesScarlet oak (*Quercus coccinea*)Black oak (*Quercus velutina*)**Other Tree Associates**Southern yellow pine (*Pinus echinata*)Shagbark hickory (*Carya ovata*)Mockernut hickory (*Carya tomentosa*)Post oak (*Quercus stellata*)

131. Cherty ridge top above limestone slopes along Fourche à Renault Creek, sec. 15, T. 37 N., R. 1 E., one and one-half miles north of Shirley, Washington County.

Dominant TreesBlack jack oak (*Quercus marilandica*)Black walnut (*Juglans nigra*)Post oak (*Quercus stellata*)White oak (*Quercus alba*)Shagbark hickory (*Carya ovata*)Southern yellow pine (*Pinus echinata*)Scarlet oak (*Quercus coccinea*)Bitternut hickory (*Carya cordiformis*)**Dominant Understory**High-bush huckleberry (*Vaccinium
stamineum* var. *neglectum*)Flowering dogwood (*Cornus florida*)Winged sumac (*Rhus Copallina*)

132. East-facing cherty slopes above limestone bluffs along Brazil Creek, sec. 28, T. 38 N., R. 1 W., six miles northeast of Berryman, Washington County.

Dominant TreesSouthern yellow pine (*Pinus echinata*)Shagbark hickory (*Carya ovata*)Post oak (*Quercus stellata*)Black oak (*Quercus velutina*)Black jack oak (*Quercus marilandica*)Black walnut (*Juglans nigra*)**Dominant Understory**High-bush huckleberry (*Vaccinium stamineum* var. *neglectum*)

133. Cherty slopes along Coldwater Creek, sec. 33, T. 35 N., R. 8 E., three miles northeast of Womack, St. Francois County.

Dominant TreesWhite oak (*Quercus alba*)Scarlet oak (*Quercus coccinea*)Black oak (*Quercus velutina*)Southern yellow pine (*Pinus echinata*)**Other Tree Associates**Post oak (*Quercus stellata*)Northern red oak (*Quercus borealis* var. *maxima*)Black jack oak (*Quercus marilandica*)Shagbark hickory (*Carya ovata*)

Dominant Understory

- | | |
|--|--|
| Red maple (<i>Acer rubrum</i>) | Farkleberry (<i>Vaccinium arboreum</i> var. <i>glaucescens</i>) |
| Flowering dogwood (<i>Cornus florida</i>) | |
| Azalea (<i>Rhododendron nudiflorum</i> var. <i>roseum</i>) | Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>) |
| Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>) | |

134. Upland, level, wooded tract, just east of Bardley CCC camp, sec. 23, T. 24 N., R. 2 W., one and one-half miles west of Pine, in Ripley County.

Dominant Trees

- | | |
|---|---|
| Black jack oak (<i>Quercus marilandica</i>) | Shagbark hickory (<i>Carya ovata</i>) |
|---|---|

Other Tree Associates

- | | |
|--|--|
| Southern yellow pine (<i>Pinus echinata</i>) | Southern red oak (<i>Quercus falcata</i>) |
| Scarlet oak (<i>Quercus coccinea</i>) | Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>) |
| Post oak (<i>Quercus stellata</i>) | |
| White oak (<i>Quercus alba</i>) | |

Dominant Understory

- | | |
|---------------------------------------|--|
| Dwarf sumac (<i>Rhus Copallina</i>) | New Jersey tea (<i>Ceanothus americanus</i>) |
|---------------------------------------|--|

Other Understory Associates

- | | |
|--|---|
| Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>) | Smooth sumac (<i>Rhus glabra</i>) |
| | Dogwood (<i>Cornus florida</i>) |
| High-bush huckleberry (<i>Vaccinium stamineum</i> var. <i>neglectum</i>) | Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>) |
| Summer grape (<i>Vitis aestivalis</i>) | |

Dominant Herbaceous Non-Grass Plant

- Bush clover (*Lespedeza procumbens*)

Dominant Grasses

- | | |
|--|---------------------------------------|
| Panic grass (<i>Panicum dichotomum</i>) | Panic grass (<i>Panicum Boscii</i>) |
| Panic grass (<i>Panicum sphaerocarpon</i>) | |

135. Ridge top in sec. 30, T. 26 N., R. 4 E., six miles southeast of Ellsinore, in Carter County.

Dominant Trees

- | | |
|---|--|
| Scarlet oak (<i>Quercus coccinea</i>) | Southern yellow pine (<i>Pinus echinata</i>) |
|---|--|

Other Tree Associates

- | | |
|---|---|
| Black oak (<i>Quercus velutina</i>) | Pignut hickory (<i>Carya ovalis</i> var. <i>obovalis</i>) |
| Spanish oak (<i>Quercus falcata</i>) | |
| White oak (<i>Quercus alba</i>) | Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>) |
| Post oak (<i>Quercus stellata</i>) | |
| Black jack oak (<i>Quercus marilandica</i>) | |

Chief Understory

- | | |
|---|---|
| Winged sumac (<i>Rhus Copallina</i>) | Catbrier (<i>Smilax glauca</i> var. <i>leurophylla</i>) |
| Farkleberry (<i>Vaccinium arboreum</i> var. <i>glaucescens</i>) | |

Other Understory Associates

- | | |
|--|---|
| Staghorn sumac (<i>Rhus glabra</i>) | Flowering dogwood (<i>Cornus florida</i>) |
| Fragrant sumac (<i>Rhus aromatica</i>) | Persimmon (<i>Diospyros virginiana</i>) |

Dominant Herbaceous Non-Grass Plants

Pinweed (<i>Lechea tenuifolia</i>)	Horsemint (<i>Monarda Bradburiana</i>)
Cinquefoil (<i>Potentilla simplex</i> var. <i>typica</i>)	Pennyroyal (<i>Hedeoma pulegioides</i>)
	Dittany (<i>Cunila origanoides</i>)

Other Herbaceous Associates

Bush clover (<i>Lespedeza procumbens</i>)	Bush clover (<i>Lespedeza repens</i>)
Bush clover (<i>Lespedeza virginica</i>)	Forked chickweed (<i>Paronychia fastigiata</i> var. <i>typica</i>)
Sweet everlasting (<i>Gnaphalium obtusifolium</i>)	Fleabane (<i>Erigeron ramosus</i>)

Dominant Grasses and Grass-like Plants

Panic grass (<i>Panicum lanuginosum</i> var. <i>fasciculatum</i>)	Panic grass (<i>Panicum dichotomum</i>)
	Rush (<i>Juncus macer</i>)

Other Grasses and Grass-like Associates

Poverty grass (<i>Aristida dichotoma</i>)	Sedge (<i>Carex hirsutella</i>)
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136. West-facing, cherty, limestone slopes along Fourche à Renault Creek, sec. 15, T. 37 N., R. 1 E., one and one-half miles north of Shirley, Washington County.

Dominant Trees

Southern yellow pine (<i>Pinus echinata</i>)	Scarlet oak (<i>Quercus coccinea</i>)
White oak (<i>Quercus alba</i>)	

Other Tree Associates

Black walnut (<i>Juglans nigra</i>)	Black gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)
Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)	
Shingle oak (<i>Quercus imbricaria</i>)	

Dominant Understory

Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*)

Other Understory Associates

Farkleberry (<i>Vaccinium arboreum</i> var. <i>glaucescens</i>)	Winged sumac (<i>Rhus Copallina</i>)
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Dominant Herbaceous Non-Grass Plants

Dittany (<i>Cunila origanoides</i>)	Pussy toes (<i>Antennaria plantaginifolia</i>)
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Dominant Grasses and Grass-like Plants

Blue-stem (<i>Andropogon scoparius</i> var. <i>genuinus</i>)	Wild oats grass (<i>Danthonia spicata</i>)
Sedge (<i>Carex artilecta</i>)	Broom sedge (<i>Andropogon virginicus</i> var. <i>genuinus</i>)

137. South and southeast-facing, porphyritic trachyte slopes of Johnson Mountain, sec. 24, T. 35 N., R. 1 E., two miles south of Peoria, Iron County.

Dominant Trees

White oak (<i>Quercus alba</i>)	Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)
Scarlet oak (<i>Quercus coccinea</i>)	Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)
Black oak (<i>Quercus velutina</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
Southern yellow pine (<i>Pinus echinata</i>)	Shagbark hickory (<i>Carya ovata</i>)
Black gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)	Red maple (<i>Acer rubrum</i>)
Post oak (<i>Quercus stellata</i>)	

Dominant Understory

Flowering dogwood (<i>Cornus florida</i>)	Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>)
Farkleberry (<i>Vaccinium arboreum</i> var. <i>glaucescens</i>)	Winged sumac (<i>Rhus Copallina</i>)

V. QUERCUS ALBA-ACER RUBRUM ASSOCIATION**(1) *Cornus florida*-*Nyssa sylvatica* Associes**

138. Gravelly draw in upland, level woods around Little Scotia Pond, sec. 25-26, T. 33 N., R. 4 W., four miles east of Turtle, Dent County.

Dominant Trees

Red maple (<i>Acer rubrum</i>)	Flowering dogwood (<i>Cornus florida</i>)
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Dominant Understory

Farkleberry (<i>Vaccinium arboreum</i> var. <i>glaucescens</i>)	Shrubby St. John's-wort (<i>Hypericum prolificum</i>)
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(2) *Acer rubrum*-*Carya tomentosa* Associes

139. Cherty upper slopes overlying cherty acid soil between Saunders and Pine Ridge, Christian County.

Dominant Trees

Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)	Red maple (<i>Acer rubrum</i>)
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Tree Associate

Southern yellow pine (*Pinus echinata*)

Dominant Understory

Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*)

Other Understory Associates

Wild rose (<i>Rosa carolina</i>)	Wild rose (<i>Rosa subserrulata</i>)
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Dominant Herbaceous Non-Grass Plant

Flowering spurge (*Euphorbia corollata*)

Dominant Grass

Broom sedge (*Andropogon virginicus* var. *genuinus*)

140. North-facing, porphyritic trachyte slopes of Johnson Mountain, sec. 24, T. 35 N., R. 1 E., two miles south of Peoria, Iron County.

Dominant Trees

White oak (<i>Quercus alba</i>)	Black gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	Shagbark hickory (<i>Carya ovata</i>)
Red maple (<i>Acer rubrum</i>)	Mockernut hickory (<i>Carya tomentosa</i>)

Dominant Understory

Flowering dogwood (*Cornus florida*)

141. Lower cherty slopes of Stilwell Hollow, Low Gap Game Refuge, southeast of Black U. S. Lookout, sec. 12, T. 32 N., R. 1 E., four miles southwest of Black, Reynolds County.

Dominant Trees

Southern yellow pine (*Pinus echinata*) Red maple (*Acer rubrum*)

Dominant Understory

Hop hornbeam (<i>Ostrya virginiana</i>)	Smooth sumac (<i>Rhus glabra</i>)
Serviceberry, Juneberry (<i>Amelanchier canadensis</i>)	Winged sumac (<i>Rhus Copallina</i>)
Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>)	High-bush huckleberry (<i>Vaccinium stamineum</i> var. <i>neglectum</i>)
Wild honeysuckle (<i>Lonicera flava</i>)	Farkleberry (<i>Vaccinium arboreum</i> var. <i>glaucescens</i>)

142. Slight draw on upper south-facing portion of porphyritic trachyte slopes of Little Pilot Knob, sec. 36, T. 38 N., R. 1 W., three miles northwest of Floyd, Washington County.

Dominant Trees

Red maple (<i>Acer rubrum</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)	Southern yellow pine (<i>Pinus echinata</i>)
Black oak (<i>Quercus velutina</i>)	White oak (<i>Quercus alba</i>)

(3) *Quercus alba*—*Acer rubrum* Associates

143. Draw in ravine in pine-oak woods south of Bunker CCC camp F-7, sec. 3, T. 32 N., R. 3 W., five miles northwest of Bunker, near Reynolds County line, in Dent County.

Dominant Trees

Red maple (<i>Acer rubrum</i>)	Ozark pignut hickory (<i>Carya Buckleyi</i> var. <i>arkansana</i>)
Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)	White oak (<i>Quercus alba</i>)

Dominant Understory

Hazelnut (<i>Corylus americana</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
Dwarf sumac (<i>Rhus Copallina</i>)	

144. Cherty, sandstone, shallow slopes along headwaters of Big Creek, sec. 10, T. 31 N., R. 3 W., south of Bunker U. S. Lookout, five miles southwest of Bunker, in Shannon County.

Dominant Trees

Mockernut hickory (<i>Carya tomentosa</i>)	Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)
White oak (<i>Quercus alba</i>)	

Other Tree Associates

Scarlet oak (<i>Quercus coccinea</i>)	Red maple (<i>Acer rubrum</i>)
Southern yellow pine (<i>Pinus echinata</i>)	Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)
Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)	
Winged elm (<i>Ulmus alata</i>)	

Dominant Understory

Ozark witch hazel (*Hamamelis vernalis*) Buck brush (*Symphoricarpos orbiculatus*)

Other Understory Associates

Flowering dogwood (*Cornus florida*) Juneberry, serviceberry (*Amelanchier canadensis*)
 Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*) Black haw (*Viburnum rufidulum*)

145. Cherty, upper, south-facing slopes along Big Barren Creek, sec. 4, T. 25 N., R. 1 W., three miles southwest of Eastwood, 10 miles northwest of Bennett, Carter County.

Dominant Trees

White oak (*Quercus alba*) Sour gum (*Nyssa sylvatica* var. *caroliniana*)
 Southern yellow pine (*Pinus echinata*)
 Red maple (*Acer rubrum*)

Other Tree Associates

Post oak (*Quercus stellata*) Scarlet oak (*Quercus coccinea*)

Dominant Understory

Shadbush (*Amelanchier canadensis*)

Other Understory Associates

Fragrant sumac (*Rhus aromatica*) High-bush huckleberry (*Vaccinium stamineum* var. *neglectum*)
 Dwarf sumac (*Rhus Copallina*)
 Hazelnut (*Corylus americana*) Farkleberry (*Vaccinium arboreum* var. *glaucescens*)
 Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*)

Dominant Herbaceous Non-Grass Plants

Dittany (*Cunila origanoides*) Tick trefoil (*Desmodium rotundifolium*)
 Bracken fern (*Pteridium latiusculum* var. *pseudocaudatum*) Goat's rue (*Tephrosia virginiana*)
 Bush clover (*Lespedeza hirta*) Christmas fern (*Polystichum acrostichoides*)
 Tick trefoil (*Desmodium marilandicum*)

Dominant Grass

Fescue grass (*Festuca paradoxa*)

146. Cherty slopes along headwaters of Big Creek, sec. 5, T. 31 N., R. 3 W., two miles south of Melton, Shannon County.

Dominant Trees

White oak (*Quercus alba*) Scarlet oak (*Quercus coccinea*)

Other Tree Associates

Southern yellow pine (*Pinus echinata*) Red maple (*Acer rubrum*)
 Sour gum (*Nyssa sylvatica* var. *caroliniana*) Black oak (*Quercus velutina*)

147. Wooded, north-facing, cherty slopes along Eleven Points River between mouth of White's Creek and Bliss Spring, sec. 7, T. 24 N., R. 2 W., two and one-half miles southwest of Wilderness, Oregon County.

Dominant Trees

- | | |
|---|---|
| Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>) | White oak (<i>Quercus alba</i>) |
| Bitternut hickory (<i>Carya cordiformis</i>) | Scarlet oak (<i>Quercus coccinea</i>) |

Other Tree Associates

- | | |
|--|---|
| Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>) | Persimmon (<i>Diospyros virginiana</i>) |
| Red maple (<i>Acer rubrum</i>) | Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>) |
| Mockernut hickory (<i>Carya tomentosa</i>) | Slippery elm (<i>Ulmus fulva</i>) |
| Dogwood (<i>Cornus florida</i>) | |
| Red mulberry (<i>Morus rubra</i>) | |

Dominant Understory

- | | |
|---|--|
| Pink azalea (<i>Rhododendron nudiflorum</i> var. <i>roseum</i>) | Hop hornbeam (<i>Ostrya virginiana</i>) |
| Hazelnut (<i>Corylus americana</i>) | Smooth sumac (<i>Rhus glabra</i>) |
| Redbud (<i>Cercis canadensis</i>) | Rough-leaved dogwood (<i>Cornus asperifolia</i>) |
| Shadbush (<i>Amelanchier canadensis</i>) | Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>) |
| Pawpaw (<i>Asimina triloba</i>) | |

148. Cherty slopes south of Rockhouse Spring, sec. 33, T. 23 N., R. 26 W., two miles west of Lohmer, Barry County.

Dominant Trees

- | | |
|---------------------------------------|---|
| Black oak (<i>Quercus velutina</i>) | Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>) |
| White oak (<i>Quercus alba</i>) | Chinquapin (<i>Castanea ozarkensis</i>) |
| Red maple (<i>Acer rubrum</i>) | |

Other Tree Associates

- | | |
|---|--|
| Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>) | Mockernut hickory (<i>Carya tomentosa</i>) |
|---|--|

Dominant Understory

- | | |
|---|--|
| Flowering dogwood (<i>Cornus florida</i>) | Low-bush huckleberry (<i>Vaccinium vacillans</i> var. <i>crinitum</i>) |
| Juneberry, serviceberry (<i>Amelanchier canadensis</i>) | |

Other Understory Associates

- | | |
|--|---------------------------------------|
| High-bush huckleberry (<i>Vaccinium stamineum</i>) | Hazelnut (<i>Corylus americana</i>) |
|--|---------------------------------------|

Dominant Herbaceous Non-Grass Plants

- | | |
|---|--|
| Bracken (<i>Pteridium latiusculum</i> var. <i>pseudocaudatum</i>) | Pussy toes (<i>Antennaria plantaginifolia</i>) |
| Dittany (<i>Cunila origanoides</i>) | Horsemint (<i>Monarda Bradburiana</i>) |

Other Herbaceous Non-Grass Plant Associates

- | | |
|---|--|
| Dwarf dandelion (<i>Krigia biflora</i>) | Bush clover (<i>Lespedeza procumbens</i>) |
| Bedstraw (<i>Galium arkansanum</i>) | Lead plant (<i>Amorpha canescens</i> f. <i>glabrata</i>) |
| Rue anemone (<i>Anemonella thalictroides</i>) | Bracted wild indigo (<i>Baptisia leucophaea</i>) |
| Tick trefoil (<i>Desmodium rotundifolium</i>) | Flowering spurge (<i>Euphorbia corollata</i>) |
| Tick trefoil (<i>Desmodium Dillenii</i>) | |
| Bush clover (<i>Lespedeza hirta</i>) | |
| Black cohosh (<i>Cimicifuga racemosa</i>) | |

Dominant Grass-like Plant

- Sedge (*Carex cephalophora*)

149. Northwest-facing, cherty, sandstone, wooded slopes along Little Sinking Creek, sec. 26, T. 32 N., R. 3 W., two miles southwest of Bunker, Dent County.

Dominant Trees

Northern red oak (*Quercus borealis* var. *maxima*) Red maple (*Acer rubrum*)

Other Tree Associates

Black gum (*Nyssa sylvatica* var. *caroliniana*) White oak (*Quercus alba*)

Dominant Understory

Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*) Hop hornbeam (*Ostrya virginiana*)
Ironwood (*Carpinus caroliniana*)

150. Cherty ravine floor and adjacent lower slopes in Stilwell Hollow, Low Gap Game Refuge, southeast of Black U. S. Lookout, sec. 12, T. 32 N., R. 1 E., four miles southwest of Black, Reynolds County.

Dominant Trees

White oak (*Quercus alba*) Northern red oak (*Quercus borealis* var. *maxima*)
Black gum (*Nyssa sylvatica* var. *caroliniana*)

Other Tree Associates

Shagbark hickory (*Carya ovata*) Sassafras (*Sassafras albidum* var. *molle*)
Black oak (*Quercus velutina*) Butternut (*Juglans cinerea*)
Scarlet oak (*Quercus coccinea*) Sycamore (*Platanus occidentalis*)
Southern yellow pine (*Pinus echinata*) Slippery elm (*Ulmus fulva*)
Red maple (*Acer rubrum*) Red mulberry (*Morus rubra*)

Dominant Understory

Hazelnut (*Corylus americana*) Low-bush huckleberry (*Vaccinium vacillans* var. *crinitum*)
Serviceberry, Juneberry (*Amelanchier canadensis*) Fragrant sumac (*Rhus aromatica*)
Flowering dogwood (*Cornus florida*) Spicebush (*Benzoin aestivale*)
Ironwood (*Carpinus caroliniana*) Elderberry (*Sambucus canadensis*)
Black haw (*Viburnum rufidulum*) Alternate-leaved dogwood (*Cornus alternifolia*)
Ozark witch hazel (*Hamamelis vernalis*) Climbing rose (*Rosa setigera* var. *tomentosa*)
Smooth alder (*Alnus rugosa*)

Dominant Grasses and Grass-like Plants

Panic grass (*Panicum Boscii*) Panic grass (*Panicum lanuginosum* var. *Lindheimeri*)
Panic grass (*Panicum zalapense*)
Panic grass (*Panicum dichotomum*) Sedge (*Carex cephalophora*)

151. Woods along headwaters of Big Creek, sec. 5, T. 31 N., R. 3 W., two miles south of Melton, Shannon County.

Dominant Trees

Northern red oak (*Quercus borealis* var. *maxima*) White oak (*Quercus alba*)

Other Tree Associates

Mockernut hickory (<i>Carya tomentosa</i>)	Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)
Red maple (<i>Acer rubrum</i>)	Winged elm (<i>Ulmus alata</i>)
Scarlet oak (<i>Quercus coccinea</i>)	Southern yellow pine (<i>Pinus echinata</i>)

Dominant Understory

Ozark witch hazel (*Hamamelis vernalis*; along stream bed)

Other Understory Associates

Juneberry, serviceberry (<i>Amelanchier canadensis</i>)	Flowering dogwood (<i>Cornus florida</i>)
Buck brush (<i>Symphoricarpos orbiculatus</i>)	Black haw (<i>Viburnum rufidulum</i>)
	Winter grape (<i>Vitis cinerea</i>)

152. Cherty quartzitic slopes of ravine tributary to Huzzah Creek, two miles southeast of Davisville, Crawford County.

Dominant Trees

White oak (<i>Quercus alba</i>)	Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)
Northern red oak (<i>Quercus borealis</i> var. <i>maxima</i>)	

Other Tree Associates

Winged elm (<i>Ulmus alata</i>)	Red mulberry (<i>Morus rubra</i>)
-----------------------------------	-------------------------------------

Dominant Understory

Flowering dogwood (*Cornus florida*)

Other Understory Associates

Sassafras (<i>Sassafras albidum</i> var. <i>molle</i>)	Hop hornbeam (<i>Ostrya virginiana</i>)
--	---

Dominant Herbaceous Non-Grass Plants

Dittany (<i>Cunila origanoides</i>)	Bedstraw (<i>Galium arkansanum</i>)
Honeysuckle (<i>Lonicera flava</i>)	

153. Gravelly wash in draw in upland off North Fork Hollow, near Cane Creek, sec. 8, T. 26 N., R. 4 E., six miles east of Ellsinore, south of Upalika, near Wayne County line, in Butler County.

Dominant Trees

Sour gum (<i>Nyssa sylvatica</i> var. <i>caroliniana</i>)	Red maple (<i>Acer rubrum</i>)
	White oak (<i>Quercus alba</i>)

Other Tree Associates

Mulberry (<i>Morus rubra</i>)	American elm (<i>Ulmus americana</i>)
Shingle oak (<i>Quercus imbricaria</i>)	

Chief Understory

Hazelnut (<i>Corylus americana</i>)	Prairie willow (<i>Salix humilis</i>)
Flowering dogwood (<i>Cornus florida</i>)	Shrubby St. John's-wort (<i>Hypericum prolificum</i>)
Black haw (<i>Viburnum rufidulum</i>)	
Possum haw (<i>Ilex decidua</i>)	

154. Small gravel wash along slight gradient of ravine slope, near Cane Creek, sec. 8, T. 26 N., R. 4 E., six miles east of Ellsinore, south of Upalika, near Wayne County line, in Butler County.

Dominant Trees

White oak (*Quercus alba*)
 Red maple (*Acer rubrum*)

Sour gum (*Nyssa sylvatica* var. *caroliniana*)

Other Tree Associates

Shingle oak (*Quercus imbricaria*)

American elm (*Ulmus americana*)

Dominant Understory

Possum haw, deciduous holly (*Ilex
 decidua*)
 Dogwood (*Cornus florida*)
 Prairie willow (*Salix humilis*)

Hazelnut (*Corylus americana*)
 Black haw (*Viburnum rufidulum*)
 Red mulberry (*Morus rubra*)

155. Lamotte sandstone bluffs along Pickle Creek, Pickle Springs, sec. 20, T. 36 N., R. 7 E., six miles northwest of Coffman, Sainte Genevieve County.

Dominant Trees

Scarlet oak (*Quercus coccinea*)
 White oak (*Quercus alba*)
 Southern yellow pine (*Pinus echinata*)

Black oak (*Quercus velutina*)
 Red maple (*Acer rubrum*)

Dominant Understory

Farkleberry (*Vaccinium arboreum* var. *glaucescens*)

Greenbrier (*Smilax glauca* var. *leurophylla*)

156. Lamotte sandstone ravine along Pickle Creek, Pickle Springs, sec. 29, T. 36 N., R. 7 E., six miles northwest of Coffman, Sainte Genevieve County.

Dominant Trees

Red maple (*Acer rubrum*)
 Sour gum (*Nyssa sylvatica* var. *caroliniana*)
 Northern red oak (*Quercus borealis* var. *maxima*)

White oak (*Quercus alba*)
 Black oak (*Quercus velutina*)
 Sassafras (*Sassafras albidum* var. *molle*)
 Bitternut hickory (*Carya cordiformis*)
 Mockernut hickory (*Carya tomentosa*)

Dominant Shrubs

Flowering dogwood (*Cornus florida*)
 Juneberry, serviceberry (*Amelanchier
 canadensis*)
 Hop hornbeam (*Ostrya virginiana*)
 Ironwood (*Carpinus caroliniana*)

Greenbrier (*Smilax glauca* var. *leurophylla*)
 Smooth alder (*Alnus rugosa*)
 Low-bush huckleberry (*Vaccinium
 vacillans* var. *crinitum*)

157. Ravine bottom woods along Coldwater Creek, sec. 33, T. 35 N., R. 8 E., three miles northeast of Womack, St. Francois County.

Dominant Trees

White oak (*Quercus alba*)

Sycamore (*Platanus occidentalis*)

Other Tree Associates

Red maple (*Acer rubrum*)
 Sugar maple (*Acer saccharum*)
 Shagbark hickory (*Carya ovata*)

American elm (*Ulmus americana*)
 Sour gum (*Nyssa sylvatica*)

Dominant Understory

Smooth alder (*Alnus rugosa*) Hazelnut (*Corylus americana*)

Other Understory Associates

Spicebush (*Benzoin aestivale*) Ward's willow (*Salix longipes* var.
Dogwood (*Cornus florida*) *Wardii*)

158. Wooded floor of ravine tributary to headwaters of Brazil Creek, sec. 28, T. 38 N., R. 1 W., six miles northeast of Berryman, Washington County.

Dominant Trees

White oak (*Quercus alba*) Bitternut hickory (*Carya cordiformis*)
Scarlet oak (*Quercus coccinea*) Sassafras (*Sassafras albidum* var. *molle*)
Mockernut hickory (*Carya tomentosa*) Red maple (*Acer rubrum*)

Dominant Understory

Flowering dogwood (*Cornus florida*) Hazelnut (*Corylus americana*)

159. Slight draw on upper east-facing portion of porphyritic trachyte slopes of Little Pilot Knob, sec. 36, T. 38 N., R. 1 W., three miles northwest of Floyd, Washington County.

Dominant Trees

Southern yellow pine (*Pinus echinata*) Northern red oak (*Quercus borealis* var.
Sassafras (*Sassafras albidum* var. *molle*) *maxima*)
Sour gum (*Nyssa sylvatica* var. *caroliniana*) Black oak (*Quercus velutina*)
Persimmon (*Diospyros virginiana*)

Dominant Understory

Flowering dogwood (*Cornus florida*)

160. Cherty slopes along Little Fourche à Renault Creek, sec. 2, T. 37 N., R. 1 E., two miles southeast of Floyd, Washington County.

Dominant Trees

Southern yellow pine (*Pinus echinata*) White oak (*Quercus alba*)
Red maple (*Acer rubrum*)

Dominant Understory

Flowering dogwood (*Cornus florida*)

SUBCLIMAX STAGE C***Ulmus americana* Subclimax**

161. Upper, cherty portion of northeast-facing limestone slopes along St. Francis River, just west of Greenville, Wayne County.

Dominant Trees

American elm (*Ulmus americana*) Slippery elm (*Ulmus fulva*)

Dominant Understory

Shadbush, serviceberry (*Amelanchier* Winged elm (*Ulmus alata*)
canadensis) Hop hornbeam (*Ostrya virginiana*)

MIXED ASSOCIATIONS WHERE ONE HAS PENETRATED AND INTERGRADED INTO ANOTHER

162. Porphyritic trachyte "shut-in" along Marble Creek, sec. 21, T. 32 N., R. 5 E., two and one-half miles southwest of French Mills, Madison County.

Dominant Trees

Winged elm (*Ulmus alata*)
Scarlet oak (*Quercus coccinea*)

White oak (*Quercus alba*)

Other Tree Associates

Southern yellow pine (*Pinus echinata*)
Red cedar (*Juniperus virginiana*)
Northern red oak (*Quercus borealis* var.
maxima)
Mockernut hickory (*Carya tomentosa*)

River birch (*Betula nigra*)
Sour gum (*Nyssa sylvatica* var. *caroliniana*)
American elm (*Ulmus americana*)
Red maple (*Acer rubrum*)

Dominant Understory

Ozark witch hazel (*Hamamelis vernalis*)
Smooth alder (*Alnus rugosa*)
Swamp dogwood (*Cornus obliqua*)
Greenbrier (*Smilax Bona-nox*)

Sycamore (*Platanus occidentalis*)
Greenbrier (*Smilax glauca* var. *leurophylla*)

163. Porphyritic trachyte slopes along St. Francis River, sec. 10, T. 32 N., R. 5 E., two miles north of French Mills, Madison County.

Dominant Trees

Sugar maple (*Acer saccharum* var. *glaucum*)
 Red maple (*Acer rubrum*)
 Sour gum (*Nyssa sylvatica* var. *caroliniana*)
 Sweet gum (*Liquidambar Styraciflua*)

Northern red oak (*Quercus borealis* var.
maxima)
Linden (*Tilia glabra*)
Red mulberry (*Morus rubra*)
White oak (*Quercus alba*)
Winged elm (*Ulmus alata*)

Dominant Understory

Flowering dogwood (*Cornus florida*)
Pawpaw (*Asimina triloba*)
Ironwood (*Carpinus caroliniana*)

Hop hornbeam (*Ostrya virginiana*)
Bristly greenbrier (*Smilax hispida*)
Greenbrier (*Smilax Bona-nox*)

164. Porphyritic trachyte slopes along "shut-in" of Telleck Branch, sec. 23, T. 35 N., R. 1 E., three and one-half miles northwest of Shepherd, Iron County.

Dominant Trees

Southern yellow pine (*Pinus echinata*)
Red cedar (*Juniperus virginiana*)
Sugar maple (*Acer saccharum* var.
glaucum)
White oak (*Quercus alba*)
Winged elm (*Ulmus alata*)

Northern red oak (*Quercus borealis* var. *maxima*)
Black gum (*Nyssa sylvatica* var. *caroliniana*)
Red maple (*Acer rubrum*)
Persimmon (*Diospyros virginiana*)

Dominant Understory

Indian cherry (*Rhamnus caroliniana*)

STUDIES OF
THE VEGETATION OF MISSOURI—II
PHANEROGAMIC FLORA OF THE FRESH-WATER SPRINGS
IN THE OZARKS OF MISSOURI

BY

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CONTENTS

	PAGE
LIST OF ILLUSTRATIONS	481
GENERAL DISCUSSION OF OZARK SPRINGS	483
Introduction	483
Extent of work	483
Springs: Their definition, occurrence, nature, uses, and size	484
Discussion of vegetation of springs	488
Differentiation and distinguishing characters of species found in springs	502
Geographical distribution of species found in springs	507
The influence of springs on the Missouri flora	532
Key to species.	533
DESCRIPTION OF THE CHIEF SPRINGS IN THE OZARKS	537

LIST OF ILLUSTRATIONS

PLATES

- I. Althea Spring, Ozark County. Spring branch near confluence with North Fork of White River.
Bennett Spring, Laclede County.
- II. Big Spring, Carter County. Part of spring branch, showing mats of *Myriophyllum heterophyllum*.
Big Spring, Carter County.
- III. Big Spring, Lawrence County.
Big Spring, Carter County.
- IV. Blue Spring, Laclede County.
Boze Mill Spring, Oregon County.
- V. Blue Spring, Oregon County.
Cave Spring, Shannon County. Head of spring.
- VI. Chesapeake Spring, Lawrence County.
Creasy Spring, Pulaski County.
- VII. Creasy Spring, Pulaski County.
Keener Spring, Butler County. Head of spring.
- VIII. Keener Spring, Butler County. Head of spring.
Carter Spring, Reynolds County. Head of spring.
- IX. Carter Spring, Reynolds County. Narrow lower part of spring branch.
Waynesville Spring, Pulaski County. Head of spring.
- X. Warner Bay Spring, Reynolds County. Head of spring.
Wildier Spring, Ozark County. Head of spring.
- XI. Gravois Mills Spring, Morgan County. One of spring-fed basins.
Gravois Mills Spring, Morgan County. Lower part of spring branch.
- XII. Montauk Spring, Dent County. One of heads of spring, showing island of *Rorippa Nasturtium-aquaticum*.
Montauk Spring, Dent County. Junction of spring heads.
- XIII. Welch Spring, Shannon County. Head of spring.
Double Spring, Ozark County. Head of spring.
- XIV. Double Spring, Ozark County.
Gaines Ford Spring, Maries County. Head of spring.
- XV. Greer Spring, Oregon County. Upper outlet of spring.
Greer Spring, Oregon County. Lower outlet of spring.
- XVI. Hahatonka Spring, Camden County.
Hazleton Spring, Texas County. Part of spring branch.
- XVII. Hodgson Mill Spring, Ozark County.
Kratz Spring, Franklin County. Head of spring.
- XVIII. Prewett Spring, Texas County. Head of spring.
Roaring River Spring, Barry County. Head of spring.

- XIX. Onandago Spring, Crawford County. Head of spring.
Relfe Spring, Phelps County. Head of spring.
- XX. Round Spring, Shannon County. Head of spring.
Stone Mill Spring, Pulaski County. Head of spring.
- XXI. Slabtown Spring, Texas County, looking down spring branch. Note
abundance of *Rorippa Nasturtium-aquaticum*.
Topaz Spring, Douglas County. Head of spring.
- XXII. Topaz Spring, Douglas County. Part of spring branch.
Turner's Mill Spring, Oregon County.
- XXIII. Round Spring, Shannon County.
Turner's Mill Spring, Oregon County.
- XXIV. Twin Springs, Dent County. Head of spring.
Twin Springs, Dent County. Spring branch.

TEXT FIGURES

	PAGE
46-49. Distribution in Missouri of the species of the fresh-water springs .	508-511
50. Distribution of <i>Potamogeton lucens</i>	513
51. Distribution of <i>Potamogeton foliosus</i> var. <i>genuinus</i>	514
52. Distribution of <i>Potamogeton foliosus</i> var. <i>macellus</i>	515
53. Distribution of <i>Potamogeton panormitanus</i> var. <i>major</i>	516
54. Distribution of <i>Potamogeton panormitanus</i> var. <i>minor</i>	517
55. Distribution of <i>Potamogeton amplifolius</i>	518
56. Distribution of <i>Ludvigia palustris</i> var. <i>americana</i>	519
57. Distribution of <i>Lemna trisulca</i>	520
58. Distribution of <i>Veronica connata</i> (●) and var. <i>glaberrima</i> (X)	521
59. Distribution of <i>Ceratophyllum demersum</i>	522
60. Distribution of <i>Eleocharis acicularis</i> var. <i>typica</i>	523
61. Distribution of <i>Anacharis occidentalis</i>	524
62. Distribution of <i>Callitriche heterophylla</i>	525
63. Distribution of <i>Myriophyllum heterophyllum</i>	526
64. Distribution of <i>Zannichellia palustris</i> var. <i>major</i>	527
65. Distribution of <i>Ranunculus longirostris</i>	528
66. Distribution of <i>Sparganium americanum</i>	529

STUDIES OF THE VEGETATION OF MISSOURI—II

JULIAN A. STEYERMARK

INTRODUCTION

The Ozarks of southern Missouri and northern Arkansas are noted for an abundance of springs. From earliest times the Ozark springs have played an important rôle in the historical development of southern Missouri. Their very abundance must necessarily have encouraged many homesteaders to settle and farm in the region. In fact, the majority of farmers in this area have settled on land containing at least one small spring. A fair proportion of Ozark farmers today depend upon pump- or bucket-drawn well water, but a considerable number are still dependent on water from springs.

Aside from their obvious use in yielding water for drinking purposes, springs have played an important rôle in the development of agriculture and stock-raising. Grist mills, for grinding corn and other grains, are usually located by and receive their power from springs. These mills at one time or another have served many a community, and the rise and development of a number of Ozark towns can be traced directly or indirectly to the establishment and use of a grist mill. In recent years a number of spring waters have been developed for the propagation of fish, especially trout. These fish can live only in the cooler temperatures of spring water. By the establishment of these hatcheries, many fish have been propagated and released into spring-fed fishing waters.

In addition to their economic value, Ozark springs are outstandingly beautiful. They are visited by increasing numbers of tourists annually, and are appreciated for their esthetic as well as recreational values. Many of the state parks in the Ozarks possess a large spring as their chief scenic feature; examples are Big Spring State Park, Roaring River State Park, Bennett Spring State Park, Montauk State Park, Chesapeake State Park, Round Spring State Park, and several others. It has been estimated that the Ozarks of Missouri and Arkansas contain a greater number of both large and small springs than any other area of similar size in North America, if not in the world.

EXTENT OF WORK

The Ozark springs are interesting also because of the unique plant life that they contain. Many of the plants found in the springs are

rare species restricted to such a habitat. Furthermore, the vegetation of the springs is conspicuously uniform and appears as a natural, distinct unit in the flora of the state. These considerations suggested that a thorough study of the flora of the springs would prove interesting from the standpoint of isolating a natural vegetational element or unit of the Ozark flora and also in studying relatively simple factors in the isolation and distribution of aquatic plants of springs.

The author began work on the springs in 1928. Since then, all the largest and most of the important springs in the Ozarks have been visited and studied. All the springs described in *Water resources of Missouri*¹ have been investigated, and many others have been visited.

All the species of phanerogams were collected from each spring. Characeae (*Chara* and *Nitella*) were also collected, as were a small number of bryophytes. In the following pages, the statements referring to the vegetation of the springs refer in practically all cases to phanerogams. A complete set of herbarium material of the species collected may be found in the Missouri Botanical Garden Herbarium. A nearly complete set is in the Herbarium of Field Museum.

It will be noted in the following pages that the material on each spring is presented in the following manner: (1) location; (2) description of spring; (3) description and arrangement of the vegetation from the head of the spring to its confluence with another body of water; and, finally (4), a list of the various species found in each spring with the dominant species noted in each case.

SPRINGS: THEIR DEFINITION, OCCURRENCE, NATURE, USES, AND SIZE

The large springs in the Ozark region are considered by Fuller,² Shepard,³ Bridge,⁴ and other geologists to be the actual surface outlets of underground streams. Their abundance throughout the Ozarks, therefore, implies a well-developed system of subterranean drainage. The explanation of the origin and nature of Ozark springs has been presented by many geologists, and is here given only in a brief résumé. Water from surface rains sinks into the strata of porous

¹ H. C. Beckman, *Water resources of Missouri*, Mo. Bur. Geol. and Mines, 20: 341-353. 1927. All quotations in the descriptions of the various springs, appearing in a later part of the paper, have been taken from this publication.

² M. L. Fuller, *Notes on certain large springs of the Ozark region*, Missouri and Arkansas, U. S. Geol. Surv. Water-Supply Paper, 110: 207-210. 1905.

³ E. M. Shepard, *Springs*, U. S. Geol. Surv. Water-Supply Paper, 102: 416-440. 1903.

⁴ J. Bridge, *Geology of the Eminence and Cardareva quadrangles*, Mo. Bur. Geol. and Mines, 2nd ser. 24: 39. 1930.

rocks below and eventually meets other water which has similarly found its way through porous substrata. The combined force of the water, from several sources, working its way down along the joints and bedding planes of the rock, gradually dissolves and enlarges passages, until an underground stream is formed. Usually the most porous zone, and the one through which the stream can cut its passage most easily, is dolomite (magnesian limestone). Eventually these streams come to the surface in the form of springs.

The spring is the terminus of this subterranean stream, but the latter may have had its origin many miles away, somewhere within the Ozark dome. The underground stream which emerges in the form of a spring may represent an original single stream without admixture or confluence of other subterranean tributary drainage. However, most of the larger springs appear to be outlets of large subterranean streams comprising a combined volume of several other tributary drainages, the sources of which may be many miles distant. In some cases the outlet of these subterranean streams is near the ground surface. In other instances, the outlet is far below the surface level, and the water is usually very deep. The outlet of most of the large subterranean streams permits free passage of the water, but in some of the smaller springs it is filled with gravel.

The springs generally occur in valleys, canyons, or deep ravines where the streams have cut down into the rock and travel through a water-bearing bed. The springs are larger, as a rule, where erosion has cut more deeply into the valleys. Often they arise at the bases of bluffs where the rock is exposed. Generally, this substratum is a cherty dolomite, mainly of Cambrian or Ordovician age. All the streams in the Ozarks are spring-fed. They are relatively clear because the spring water feeding them is largely a subterranean flow not disturbed or muddied by surface rains or overflows bearing alluvial deposits. The majority of the large springs occur along the Current, Gasconade, Black, Eleven Points, Meramec, White (North Fork), and Niangua rivers. Only a few of them are found along the St. Francis, Osage, White, Pomme de Terre, and Sac rivers and tributaries; these latter streams are generally muddier, and are more subject to floods and less uniformity of flow than the rivers that are more frequently supplied with spring water.

The occurrence of the springs is correlated with the altitude of the region. Bridge¹ found that there were no permanent springs of any size above 900 feet elevation in the Eminence-Cardareva region of

¹ Ibid., p. 36.

Shannon, Carter, and Reynolds counties, and that most of the permanent streams had their sources between the elevations of 760 and 900 feet, this indicating the permanent water table level of the region. Most of the other large springs in the Ozarks arise at an altitude generally above 700 and below 900 feet.

In their relation to the topography it has been found¹ that most of the large Ozark springs occur "close to a large valley which is either dry, or else occupied by a stream which appears much too small for the size of the valley which contains it." This is found, for example, in the case of Round Spring, located close to Spring Valley, which is usually dry.

The chief characteristics of the Ozark springs are the great clearness and cold temperature of their water. Most of them vary between 52° and 58° F. Such constant low temperatures as these are maintained principally because the subterranean streams flow at such a depth that they are not much influenced by atmospheric changes of temperature at the surface. The beauty of many of the springs depends upon their great clarity and bluish color; in general, the deeper the spring the bluer its water. Various theories have been set forth to account for this unusually deep blue color. Presence of certain minerals or particles in suspension in the water and reflection from the sky have been brought forth as arguments to explain the blue water. The most recent and most probable explanation is that of Pettit,² who explains it on the basis of the reflection and diffusion of certain light rays. His explanation calculates that light falling on the purest water, with only water molecules to intercept the shorter rays, is scattered in the deepest blue over the widest arc, whereas blues give way to white upon the increase of larger particles, catching the longer rays, in other waters. As successively clearer water samples were tested, Pettit found that the scattered light became blue and then deeper blue over a wider and wider arc, at first above the surface and then extending below, though the scattered light itself became no bluer. Dr. Pettit experimented with water from Crater Lake, settled ocean water, distilled and tap water, and dust-free water. Observation of Ozark springs in general appears to corroborate Dr. Pettit's evidence that depth combined with the purity of the water is largely responsible for the deep blue color. In some of the large Ozark springs the water is so clear that one can see the bottom at depths between 30 and 50 feet. In some of the springs

¹ *Ibid.*, pp. 41-42.

² E. Douglass, *Why Crater Lake is so blue*, Magazine Supplement, St. Louis Post Dispatch, p. 1. July 26, 1936.

the water appears milky or green. This turbidity is probably due to the presence of minute particles of suspended clay matter. On rare occasions, notably after seasons of very heavy rainfall, the water may appear slightly murky and less clear than at other times. Many samples of Ozark spring water measured by H. W. Mundt and W. D. Turner showed no turbidity, while others exhibited varying degrees of turbidity.

The flow of these springs is not constant. During the spring months, corresponding to the period of maximum rainfall, it is greatest, while during the summer and fall months the flow is least. Only a few of the smallest springs in the Ozarks have been known to go dry. All the springs show marked variations of discharge directly correlated with variations in rainfall. The maximum total number of gallons discharged in a day by Big Spring, in Carter County, was 543,000,000, with an average of 242,000,000. Greer Spring, the second largest in Missouri, flowed a maximum of 539,000,000 gallons a day, and an average of 209,000,000.

The flow of the water is very rapid. In some cases, where the outlet of the subterranean stream emerges as a deep pool far below the surface, the water may be quite still. In other springs, where the outlet is nearer the surface or has a very strong discharge, the water rushes forth or boils up violently. The rate of discharge of the water at the outlet appears to be the chief factor in causing a slow or rapid current in the spring branch. However, the fall of the water and the width of the bed are of great importance as well. In the larger springs the current in the spring branch is rapid at first, and occupies the entire width of the branch. Downstream, where the bed is usually wider and the gradient of the branch less, the main current exists in the middle, while slow or still water occurs along the sides.

The following list of the twelve largest springs in Missouri is taken from Beckman's¹ report.

Rank	Spring	County	Rank	Spring	County
1	Big	Carter	7	Blue	Shannon
2	Greer	Oregon	8	Blue	Oregon
3	Welch	Shannon	9	Alley	Shannon
4	Double	Ozark	10	Hahatonka	Camden
5	Meramec	Phelps	11	Montauk	Dent
6	Bennett	Laclede	12	Round	Shannon

Other springs ranking among the largest are Roubidoux Spring and Boiling Spring in Pulaski County, and Pulltight Spring and Cave Spring in Shannon County.

¹ H. C. Beckman, Water resources of Missouri, Mo. Bur. Geol. and Mines, 20: 341-342. 1927.

DISCUSSION OF VEGETATION OF SPRINGS

Drouet¹ is the only previous worker who has carried on any actual detailed investigation of the vegetation of Missouri springs. His work was confined principally to collections of algae, although he mentions the occurrence in a few springs of several species of spermatophytes. Some of the latter mentioned by him, originally taken from notes made by H. W. Rickett, have since been found to be based upon misdeterminations. For example, his record of *Valisneria spiralis* L. from Howe's Mill Spring is *Sparganium americanum* Nutt., and *Myriophyllum scabratum* Michx., recorded from Yancy Mill Spring, Alley Spring, and Roubidoux Spring, *Myriophyllum heterophyllum*.

Metcalf² and Rickett³ record a few spermatophytes from some of the Ozark springs, but their work was only incidental and comprised a small number of collections from only a few springs. Some of their records are based upon misdeterminations. For example, Metcalf's report of *Potamogeton Friesii* Rupr. in Hahatonka Spring has been found by Fernald to be *Potamogeton foliosus* var. *genuinus*. Rickett's report of *Najas* sp. in Yancy Mill Spring is actually *Callitriche heterophylla*, while the "*Potamogeton* sp. (probably *P. pectinatus* L.)" is *Potamogeton foliosus* var. *macellus*.

SPERMATOPHYTES OF THE OZARK SPRINGS

The following list, including all species which have been found growing in the water of the spring, spring branches, or along the margin of the springs, is based upon carefully studied living and herbarium collections which have been made over a period of ten years from the Missouri Ozark springs. Herbarium specimens of all the species studied and recorded in the following lists may be found in the herbaria of Field Museum of Natural History and the Missouri Botanical Garden.

TYPHACEAE

Typha latifolia L. Common cat-tail

SPARGANIACEAE

Sparganium americanum Nutt. Bur-reed

¹ F. Drouet, Algal vegetation of the large Ozark Springs, Trans. Amer. Micro. Soc. 52: 83-100. 1933.

² F. P. Metcalf, Notes on marsh and aquatic plants of Missouri, Journ. Wash. Acad. Sci. 12: 307-312. 1922.

³ H. W. Rickett, A list of plants from the Missouri Ozarks, Amer. Midl. Nat. 12: 411-419. 1931.

NAJADACEAE

- Potamogeton crispus* L. Curly-leaved muck-weed
Potamogeton amplifolius Tuckerm. Large-leaved pondweed
Potamogeton lucens L. Shining pondweed
Potamogeton foliosus Raf., var. *genuinus* Fern. Pondweed
Potamogeton foliosus var. *macellus* Fern. Pondweed
Potamogeton panormitanus Bivona-Bernardi, var. *minor* Biv. Pondweed
Potamogeton panormitanus var. *major* G. Fischer. Pondweed
Najas guadalupensis (Spreng.) Morong. Naiad
Zannichellia palustris L., var. *major* Boenningh. Horned pondweed

ALISMACEAE

- Sagittaria latifolia* Willd. Broad-leaved arrowhead
Alisma subcordatum Raf. Water plantain

HYDROCHARITACEAE

- Anacharis occidentalis* (Pursh) Victorin. Water-weed

GRAMINEAE

- Agrostis perennans* (Walt.) Tuckerm. Thin grass
Agrostis stolonifera L. Red top grass
Poa annua L., var. *reptans* Haussknecht. Annual bluegrass
Eragrostis hypnoides (Lam.) BSP. Creeping love grass
Leersia oryzoides (L.) Sw. Rice cut grass
Glyceria striata (Lam.) Hitchc. Fowl meadow grass

CYPERACEAE

- Eleocharis acicularis* (L.) R. & S., var. *typica* Svenson. Needle spike rush
Eleocharis acicularis var. *gracilescens* Svenson. Needle spike rush
Eleocharis calva Torr. Creeping spike rush

LEMNACEAE

- Spirodela polyrhiza* (L.) Schleid. Duckweed
Lemna trisulca L. Ivy-leaved duckweed
Lemna minor L. Little duckweed
Lemna valdiviana Philippi. Duckweed
Wolffia punctata L. Least duckweed

PONTEDERIACEAE

- Heteranthera dubia* (Jacq.) MacM. Water star-grass

JUNCACEAE

- Juncus acuminatus* Michx. Knotty-leaved rush
Juncus effusus L., var. *solutus* Fern. & Wieg. Rush
Juncus macer S. F. Gray. Slender rush

SAURURACEAE

- Saururus cernuus* L. Lizard's tail

POLYGONACEAE

- Polygonum punctatum* Ell. Smartweed, water pepper
Polygonum hydropiperoides Michx. Mild water pepper

CERATOPHYLLACEAE

- Ceratophyllum demersum* L. Hornwort

NYMPHAEACEAE

- Nuphar ozarkanum* Miller & Standley. Ozark spatterdock

RANUNCULACEAE

- Ranunculus longirostris* Godron. White water crowfoot

CRUCIFERAE

Rorippa Nasturtium-aquaticum (L.) Schinz & Thell. Water cress
Cardamine bulbosa (Schreb.) BSP., f. *fontinalis* Palmer & Steyermark. Spring cress

CALLITRICHACEAE

Callitriche heterophylla Pursh. Water starwort

LYTHRACEAE

Peplis diandra Nutt. Water purslane
Rotala ramosior (L.) Koehne, var. *interior* Fern. & Griscom. Tooth-cup

ONAGRACEAE

Ludvigia palustris (L.) Ell., var. *americana* (DC.) Fernald & Griscom. Water purslane
Epilobium coloratum Muhl. Willow herb

HALORAGIDACEAE

Myriophyllum proserpinacoides Gill. Water feather
Myriophyllum scabratum Michx. Water milfoil
Myriophyllum heterophyllum Michx. Water milfoil

LABIATAE

Mentha piperita L. Peppermint

SCROPHULARIACEAE

Lindernia dubia (L.) Pennell, var. *typica* Pennell. False pimpernel
Gratiola neglecta Torr. Clammy hedge hyssop
Veronica connata Raf. Water speedwell
Veronica connata var. *glaberrima* (Pennell) Fassett. Water speedwell

LENTIBULARIACEAE

Utricularia gibba L. Bladderwort

Of this list only the following species are found submerged in the spring water:

Sparganium americanum Nutt.
Potamogeton crispus L.
Potamogeton amplifolius Tuckerm.
Potamogeton lucens L.
Potamogeton foliosus Raf., var. *genuinus* Fern.
Potamogeton foliosus var. *macellus* Fern.
Potamogeton panormitanus Bivona-Bernardi, var. *minor* Biv.
Najas guadalupensis (Spreng.) Morong
Zannichellia palustris L., var. *major* Boenningh.
Anacharis occidentalis (Pursh) Victorin
Poa annua L., var. *repans* Haussknecht
Glyceria striata (Lam.) Hitchc.
Agrostis stolonifera L.
Eleocharis acicularis (L.) R. & S., var. *typica* Svenson
Spirodela polyrrhiza (L.) Schleid.
Lemna trisulca L.
Lemna valdiviana Philippi
Wolffia punctata L.
Heteranthera dubia (Jacq.) MacM.
Polygonum hydropiperoides Michx.
Ceratophyllum demersum L.
Ranunculus longirostris Godron
Rorippa Nasturtium-aquaticum (L.) Schinz & Thell.

Cardamine bulbosa (Schreb.) BSP., f. *fontinalis* Palmer & Steyermark
Callitriche heterophylla Pursh
Peplis diandra Nutt.
Ludwigia palustris (L.) Ell., var. *americana* (DC.) Fernald & Griscom
Myriophyllum prosperpinacoides Gill.
Myriophyllum scabratum Michx.
Myriophyllum heterophyllum Michx.
Veronica connata Raf.
Veronica connata var. *glaberrima* (Pennell) Fassett
Utricularia gibba L.

However, some of the plants included in the above list are very rarely found. The following list includes the most commonly encountered species of springs, or those more or less characteristic of all Ozark springs:

Eleocharis acicularis (L.) R. & S., var. *typica* Svenson, and var. *gracilescens* Svenson
Poa annua L., var. *reptans* Haussknecht
Sparganium americanum Nutt.
Potamogeton amplifolius Tuckerm.
Potamogeton lucens L.
Potamogeton foliosus Raf., var. *genuinus* Fern.
Potamogeton foliosus Raf., var. *macellus* Fern.
Zannichellia palustris L., var. *major* Boenningh.
Anacharis occidentalis (Pursh) Victorin
Ceratophyllum demersum L.
Rorippa Nasturtium-aquaticum (L.) Schinz & Thell.
Callitriche heterophylla Pursh
Ludwigia palustris (L.) Ell., var. *americana* (DC.) Fern. & Griscom
Myriophyllum heterophyllum Michx.
Veronica connata Raf.
Polygonum hydropiperoides Michx.
Cardamine bulbosa f. *fontinalis* Palmer & Steyermark

Of an original list of 60 species occurring in and along the water of springs, we find only 16 actually common to most of the springs. Of these 16 the three commonly found are water milfoil (*Myriophyllum heterophyllum* Nutt.), water cress (*Rorippa Nasturtium-aquaticum* (L.) Schinz & Thell.), and water starwort (*Callitriche heterophylla* Pursh).

Since the above species are the commonest ones found, it is of interest to note from which of the following springs two of them are absent:

WATER CRESS (*Rorippa Nasturtium-aquaticum*)

Amsden Mill Spring	Mill Spring
Aspley Spring	Mill Pond
Blue Spring, Ozark County	Old Pond
Boiling Spring, Pulaski County	Roaring Spring
Davidson's Blue Spring	Sands Spring
Falling Spring	Silver Lake
Gravel Spring	Tucker Bay Spring
Mabrey Spring	Turner Mill Spring
Markham Spring	Warner Bay Spring

WATER MILFOIL (*Myriophyllum heterophyllum*)

Amsden Mill Spring	Mill Creek Spring
Aspley Spring	Mill Spring
Beaver Spring	Miller Spring
Big Spring, Newton County	Montauk Spring
Bliss Spring	Mossy Spring
Blue Spring, Carter County	Piney Spring
Blue Spring, Crawford County	Prewett Spring
Boiling Spring, Texas County	Randolph Spring
Boylers Mill Spring	Roaring River Spring
Cave Spring, Greene County	Roaring Spring
Chesapeake Spring	Schlicht Spring
Cold Spring	Shanghai Spring
Coppedge Spring	Slabtown Spring
Davidson's Blue Spring	Steelville Spring
Elm Spring	Turner Mill Spring
Evans Spring	Wilkins Spring
Howe's Mill Spring	Williams Spring
Kratz Spring	

In 18 cases water cress is absent, while in 35 cases water milfoil is not recorded. Water cress, therefore, is the species which occurs the greatest number of times in the springs. In the present paper only the larger Ozark springs are described. However, it may be stated in passing that in most of the smaller Ozark springs not included in this paper water cress was found to be the dominant and commonest species. In many of these springs, in fact, it was the only aquatic spermatophyte found. Although water cress was recorded as of more frequent occurrence in the springs than any other species, it must not be inferred that it was also the dominant species. In many cases, its occurrence in the larger Ozark springs is exceeded in abundance by a number of other species. This is especially true as regards its rivals, water milfoil and water starwort, the species next most frequently occurring. These latter two species are often the most abundant and dominant ones present. Where several species are represented in a given spring, they often grow so abundantly, especially water milfoil, as to minimize the occurrence of the others in comparison.

It is of interest to note the conditions under which the two commonest species found in the springs thrive. In the case of water cress, shallow water with a gravelly substratum and a slow- to medium-flowing current appear to suit this species best. For these reasons it is the dominant and common species in all the small Ozark springs and spring branches where the water is shallow, the stream bed is gravelly, and the current not too fast. For the same reasons, water cress is absent around the heads of some of the large and deep springs where the banks slope off steeply into deeper water or where the current is too fast. For example, at Blue Spring in Ozark County,

Silver Lake, Boiling Spring in Pulaski County, and Sands Spring, to mention a few examples, the water at the head of the spring is deep, the sides of the banks are steep, and, in the case of Boiling Spring, the water boils up forcefully. No foothold is afforded for water cress in such cases.

However, where water cress does not exist around the heads of some springs, it often is found farther down along the course of the spring branch where the conditions of shallower water, less rapid stream flow, and more gravelly substrata exist. Of all the factors enumerated, shallow water appears to be the most important for the occurrence of the species.

In the case of water milfoil almost the reverse conditions seem to be necessary. It grows best where the water is rather deep, the substratum muddy, and the current slow to medium. It grows in the deepest waters, if necessary. It prefers muddy substrata. If the water is too swift and at the same time shallow, with a gravel substratum, it is likely to be absent. It, therefore, does not appear in such springs as Big Spring in Newton County, Bliss Spring, Cave Spring in Greene County, Chesapeake Spring, Kratz Spring, Mill Creek Spring, Mossy Spring, Steelville Spring, and Wilkins Spring.

The following chart shows the relative frequency of occurrence of the commonest species in the springs:

FREQUENCY OF OCCURRENCE OF SPECIES WITHIN OZARK SPRINGS

Name of plant	Rank	No. of times found
<i>Rorippa Nasturtium-aquaticum</i>	1	72
<i>Callitriche heterophylla</i>	2	54
<i>Myriophyllum heterophyllum</i>	3	53
<i>Sparganium americanum</i>	4	41
<i>Anacharis occidentalis</i>	5	38
<i>Veronica connata</i>	6	35
<i>Potamogeton foliosus</i> var. <i>genuinus</i> }.....	7	34
<i>Zannichellia palustris</i> var. <i>major</i> }.....		
<i>Ludwigia palustris</i> var. <i>americana</i>	8	32
<i>Ceratophyllum demersum</i>	9	22
<i>Potamogeton foliosus</i> var. <i>macellus</i> }.....	10	18
<i>Potamogeton lucens</i>		
<i>Ranunculus longirostris</i>	11	17
<i>Poa annua</i> var. <i>reptans</i>		
<i>Eleocharis acicularis</i> var. <i>typica</i> and var. <i>gracilescens</i> }.....	12	15
<i>Polygonum hydropiperoides</i>		
<i>Cardamine bulbosa</i> f. <i>fontinalis</i>	13	14
<i>Potamogeton amplifolius</i> }.....	14	9
<i>Mentha piperita</i>		
<i>Heteranthera dubia</i>		
<i>Alisma subcordatum</i>	15	8
<i>Nuphar ozarkanum</i> }.....	16	6
<i>Eleocharis calva</i>		
<i>Juncus acuminatus</i> }.....		
<i>Sagittaria latifolia</i>	17	5

<i>Najas guadalupensis</i>	}	18	4
<i>Glyceria striata</i>			
<i>Agrostis stolonifera</i>			
<i>Spirodela polyrrhiza</i>			
<i>Lindernia dubia</i> var. <i>typica</i>	}	19	3
<i>Penthorum sedoides</i>			
<i>Leersia oryzoides</i> ..			
<i>Saururus cernuus</i>			
<i>Lemna minor</i>	}	20	2
<i>Lemna trisulca</i>			
<i>Utricularia gibba</i>			
<i>Mentha arvensis</i> var. <i>glabrata</i>			
<i>Rumex obtusifolius</i>	}	21	1
<i>Samolus parviflorus</i>			
All others mentioned in descriptions of springs.....			

In an exceptional number of cases, only one or two species of spermatophytes occur in the springs. The following springs are examples of such a paucity of higher vegetation:

Spring	Species found
Big Spring, Newton County.....	<i>Rorippa Nasturtium-aquaticum</i>
Big Spring, Lawrence County.....	<i>Rorippa Nasturtium-aquaticum</i> <i>Myriophyllum heterophyllum</i>
Bliss Spring.....	<i>Rorippa Nasturtium-aquaticum</i> <i>Callitriche heterophylla</i>
Blue Spring, Ozark County.....	<i>Callitriche heterophylla</i>
Cave Spring, Greene County.....	<i>Rorippa Nasturtium-aquaticum</i>
Creasy Spring.....	<i>Rorippa Nasturtium-aquaticum</i> <i>Myriophyllum heterophyllum</i>
Davidson's Blue Spring.....	<i>Zannichellia palustris</i> var. <i>major</i>
Falling Spring.....	<i>Myriophyllum heterophyllum</i>
Mill Creek Spring.....	<i>Rorippa Nasturtium-aquaticum</i> <i>Potamogeton foliosus</i> var. <i>genuinus</i>
Mossy Spring.....	<i>Rorippa Nasturtium-aquaticum</i>
Roaring Spring.....	<i>Callitriche heterophylla</i>

Of the 11 springs above enumerated, it will be noted that in only four cases was water cress absent. In two instances water starwort was the only species recorded, and in a third case it was the only other species to occur. In one spring, horned pondweed was the sole species of higher plant represented, and in one spring pondweed (*Potamogeton foliosus* var. *genuinus*) was the only other plant to occur with water cress. In other words, five species of plants were found in the 11 instances in which only one or two kinds of spermatophytes existed in the springs. Of these five which occurred, water cress was most common, with water milfoil, water starwort, horned pondweed, and pondweed named in successive order of occurrence.

From what has already been stated concerning water cress and water milfoil, it will be observed that the relative abundance and distribution of the different species occurring in the springs is affected by various factors. The following factors appear to be the most significant: (1) velocity of current, (2) depth of water, and (3) type

of substratum. These factors are probably most important because they are the most variable, thereby causing a greater differentiation within a given environment. Other factors, such as temperature of the water, volume of water, amount of light, clarity, and alkalinity of the water, do not vary enough to have a marked effect on distribution and arrangement of the various species.

Most of the Ozark spring waters are decidedly alkaline in reaction as they emerge from their outlets. As shown in the analyses of spring waters in Beckman's report,¹ they are highly charged with dissolved bicarbonates and calcium carbonates. Considerable calcium and magnesium are present, as would be expected in waters coming from porous dolomitic limestone strata.

The effects of the several environmental factors in the springs react upon the species in different ways. The most noticeable factor is that of swiftness of the current and its effect upon the flowering of the species. In rapid-running water or in swift currents water milfoil, bur-reed, white water crowfoot, water speedwell, mild water pepper, and water star-grass vegetate prolifically, but nearly always are sterile. The same species growing in quiet water or rooting near the margin of the spring usually flower abundantly. This condition holds more or less true with most other species of the springs. Shining pondweed often has a different appearance in quiet and in rapid water. In quiet water the leaves are erect, wavy on the margins, and ascending, while in rapid-running water they are less wavy on the margins, and less curved. Running water appears to have a marked effect on water purslane and water speedwell, both of which grow in larger and more compact clusters and have smaller leaves under such conditions.

Deep water frequently has the same effect on plants as that produced by swift currents, namely, a tendency toward the production of vegetative or sterile shoots only. This is especially conspicuous in the case of water milfoil, bur-reed, water starwort, shining pondweed, and broad-leaved pondweed. These species often grow in the deeper waters of the spring, where they vegetate freely, but rarely, if ever, produce flowers.

In general, the main factors which appear to be associated constantly with the flowering condition of the plants are, in order of importance, (1) quiet water or remoteness from main current, (2) shallow water or lowering of water level, and (3) increased exposure

¹ H. C. Beckman, Water resources of Missouri, Mo. Bur. of Geol. and Mines, 20: 402-407. 1927.

to sunlight or desiccation. Either one or all of these conditions usually result in production of flowers.

Each of the characteristic aquatic species of the spring, i.e., those which actually grow in the water throughout the entire year, remains green and alive, at least in vegetative condition, during winter, spring, summer, and autumn. During the winter, as a rule, many of the species are in vegetative condition only. This is especially true in the case of the various pondweeds (*Potamogeton*), water purslane, water speedwell, water milfoil, bur-reed, water-weed, and white water crowfoot. Sometimes horned pondweed, water starwort, and annual bluegrass flower in winter as well as at other times of the year. Most of the aquatics mentioned, however, do not flower until late spring and summer.

Those species which usually occur along the shore and grow partly in and partly out of the water, such as lizard's tail, broad-leaved arrowhead, common cat-tail, water plantain, rice cut grass, creeping spike rush, various species of rush (*Juncus acuminatus*, *J. effusus* var. *solutus*, and *J. macer*), and others, drop their leaves and remain dormant over most of the winter and spring, renewing growth in early or late spring. As early as February some of these amphibious species, such as lizard's tail, may begin to produce a few new leaves. Water purslane, which is more nearly amphibious than any of the other truly aquatic species of the springs, often loses many of its leaves during winter, or most of them in the lower and middle portions of the plant may turn black, leaving only the uppermost leaves and tips green or flushed with orange, red, or purple.

Throughout the years of observation devoted to the study of the vegetation of the Ozark springs, the author has kept records for each spring, noting the various environmental conditions under which each species occurs. From a comparative study of these records, it has been found that some species occur most frequently under one set of conditions, while other species appeared most often when other types of environmental factors were prominent. Of course, some overlapping exists in which one species or another may tolerate or occur despite various types of conditions, which is to be expected. But, generally, it may be stated that certain types of environment favor the abundance or occurrence of one species over another. As has been stated before, the most variable factors in the springs are those of (1) depth of water, (2) velocity of current, and (3) type of substratum (mud, sand, gravel, rocks, or combinations of these).

First, there is the consideration of deep or shallow water. In order that this may be considered more conveniently, those species which favor such waters have been arranged as two classes in the following columns:

SPECIES FAVORING DEEP WATER	SPECIES FAVORING SHALLOW WATER
	Phanerogams
<i>Myriophyllum heterophyllum</i>	<i>Rorippa Nasturtium-aquaticum</i>
<i>Sparganium americanum</i>	<i>Zannichellia palustris</i> var. <i>major</i>
<i>Potamogeton amplifolius</i>	<i>Veronica connata</i> and var. <i>glaberrima</i>
<i>Potamogeton lucens</i>	<i>Eleocharis acicularis</i> and varieties
<i>Potamogeton foliosus</i> and varieties	<i>Eleocharis calva</i>
<i>Potamogeton panormitanus</i> and varieties	<i>Callitriche heterophylla</i>
<i>Ceratophyllum demersum</i>	<i>Potamogeton foliosus</i> and varieties
<i>Callitriche heterophylla</i>	<i>Ceratophyllum demersum</i>
<i>Anacharis occidentalis</i>	<i>Ranunculus longirostris</i>
<i>Nuphar ozarkanum</i>	
Cryptogams	
<i>Chara</i> spp.	
<i>Nitella</i> spp.	
<i>Porella</i> sp.	

These lists indicate that the species included in them occur most frequently in one or the other type of water. It does not signify that the species invariably lives in shallow or in deep water, but merely that it has been found most often growing under those conditions. The same is true for the other lists which follow in which other categories are used. When the same species is listed under both classes, it is evident that it is more or less ubiquitous and can exist under both conditions.

From an examination of the above lists, it will be seen that *Callitriche heterophylla*, *Potamogeton foliosus* and varieties, and *Ceratophyllum demersum* are found frequently in both deep and shallow water. It may be stated, however, that while these are equally common in one or the other, at least one, namely, *Callitriche heterophylla*, is commoner in shallow water.

Myriophyllum heterophyllum and *Potamogeton amplifolius* occur most frequently in the deepest parts of the springs, the former often frequenting the sides and bottom of the outlets of the deepest springs, and forming vegetative strands several feet in length. *Ceratophyllum demersum*, *Sparganium americanum*, *Nuphar ozarkanum*, *Potamogeton lucens*, *Chara* spp., and *Nitella* spp. are the other species that often inhabit the deeper portions of springs.

Second, there is the consideration of fast or quiet water. The following lists indicate the frequency and tolerance of the species under such conditions:

SPECIES FAVORING SWIFT WATER

SPECIES FAVORING QUIET WATER

Phanerogams

Zannichellia palustris var. *major*
Veronica connata and var. *glaberrima*
Potamogeton foliosus and varieties
Poa annua var. *reptans*
Ranunculus longirostris
Polygonum hydropiperoides
Eleocharis acicularis and varieties
Callitriche heterophylla

Cryptogams

Various mosses
 Various hepatics
 Various algae

Ceratophyllum demersum
Myriophyllum heterophyllum
Ranunculus longirostris
Sparganium americanum
Anacharis occidentalis
Callitriche heterophylla
Ludwigia palustris var. *americana*
Saururus cernuus
Potamogeton foliosus and varieties
Potamogeton amplifolius
Potamogeton lucens
Polygonum hydropiperoides
Nuphar ozarkanum
Eleocharis acicularis and varieties
Zannichellia palustris var. *major*
Veronica connata and var. *glaberrima*

Cryptogams

Chara spp.
Nitella spp.
Porella sp.

It will be noted from the above lists that many species of swift waters are listed as occurring also in quiet waters. Such species are *Zannichellia palustris* var. *major*, *Veronica connata* and var. *glaberrima*, *Potamogeton foliosus* and varieties, *Polygonum hydropiperoides*, *Ranunculus longirostris*, *Callitriche heterophylla*, and *Eleocharis acicularis* and varieties. However, the species occurring the greatest number of times in and most characteristic of the swiftest waters are *Zannichellia palustris* var. *major*, *Potamogeton foliosus* and varieties, *Poa annua* var. *reptans*, and *Veronica connata* and var. *glaberrima*. *Zannichellia palustris* var. *major* is especially common in the swifter waters. Particularly *Myriophyllum heterophyllum*, *Ceratophyllum demersum*, *Sparganium americanum*, *Callitriche heterophylla*, *Ludwigia palustris* var. *americana*, *Anacharis occidentalis*, and *Saururus cernuus* are characteristically quiet-water plants.

Other conditions being equal, a spring with quiet waters and slow currents usually harbors a greater variety and luxuriance of aquatic plants than one with swifter waters.

The third most important consideration is that of substratum. The main types of substrata in springs may be classified as mud, sand-gravel, and rock. Of these types, the mud and sand-gravel or a combination of these is the most common. Only mosses, hepatics, and algae have been recorded as growing on the loose rocks in springs. Of the other types the following lists are available:

SPECIES FAVORING MUD SUBSTRATUM

Phanerogams

Saururus cernuus
Callitriche heterophylla
Sparganium americanum
Ludvigia palustris var. *americana*
Sagittaria latifolia
Ceratophyllum demersum
Heteranthera dubia
Ranunculus longirostris
Nuphar ozarkanum
Potamogeton foliosus and varieties
Potamogeton lucens
Potamogeton amplifolius
Alisma subcordatum
Eleocharis acicularis and varieties
Rorippa Nasturtium-aquaticum
Veronica connata and var. *glaberrima*
Zannichellia palustris var. *major*

Cryptogams

Chara spp.
Nitella spp.

SPECIES FAVORING SAND-GRAVEL SUBSTRATUM

Zannichellia palustris var. *major*
Veronica connata and var. *glaberrima*
Potamogeton lucens
Potamogeton foliosus and varieties
Heteranthera dubia
Rorippa Nasturtium-aquaticum
Ranunculus longirostris
Eleocharis acicularis and varieties
Callitriche heterophylla
Sparganium americanum
Poa annua var. *repans*

The exceptions to the above lists are *Veronica connata* and var. *glaberrima*, and *Rorippa Nasturtium-aquaticum*, which are characteristic of sand-gravel substrata, but sometimes grow upon mud. On the other hand, an exception of a species occurring on the sand-gravel substratum which is most frequent and otherwise characteristic of mud is *Sparganium americanum*. *Ceratophyllum demersum*, *Sparganium americanum*, *Ludvigia palustris* var. *americana*, *Chara* spp., and *Nitella* spp. are rarely found away from mud, while *Zannichellia palustris* var. *major* is so characteristic of sand or gravel that it invariably appears on the newly deposited or small stretch of sandy or gravelly substratum occurring in a spring possessing otherwise a muddy substratum. Usually *Sparganium americanum* appears along the muddy margins of the spring, but rarely takes to pure gravel as it does where it is abundant on the gravel at the head of one of the sources of Paydown Spring, Maries County.

The species which appear on both mud and sand-gravel substrata are *Zannichellia palustris* var. *major*, *Veronica connata* and var. *glaberrima*, *Potamogeton lucens*, *Potamogeton foliosus* and varieties, *Callitriche heterophylla*, *Heteranthera dubia*, *Rorippa Nasturtium-aquaticum*, *Sparganium americanum*, *Ranunculus longirostris*, and *Eleocharis acicularis* and varieties. The preferences and exceptions of most of these species have already been discussed above.

Water cress is, as has previously been mentioned, the species occurring the greatest number of times in the springs. It also occurs most commonly on the sand-gravel type of substratum, where it is a

pioneer species and usually remains dominant. Its preference is for the sand-gravel type of substratum, but it also appears sometimes on mud substratum as a result of a filling in of mud or alluvium in the spring branch deposited over the original sand-gravel bed. This muddy or alluvial deposit may also occur as a result of the dominant growth of water cress itself. This may happen when the water cress becomes so common and luxuriant along the margin or bed of the spring branch that huge beds or colonies are formed. Then the perennial growth adds yearly deposits of particles of decomposed matter to the soil, while the latter becomes deeper and is deposited around the base of the plants. Eventually, the current is slowed, the water becomes relatively shallower around the water cress, and a deeper deposit of alluvium and mud is built up around the plants.

In the previous discussions, species have been grouped according to their preference for one or another of certain factors. Thus, where only one factor has been considered, it was found that frequent overlapping was the result and the same species was often found in either category; but when a combination of factors is considered, it is found that a much more definite preference occurs and that a certain association of species usually is present.

Thus in a combination of *deep* and *quiet* water, the following species almost invariably occur:

Myriophyllum heterophyllum
Ceratophyllum demersum
Nuphar ozarkianum
Saururus cernuus
Potamogeton amplifolius

Sparganium americanum
Potamogeton panormitanus and varieties
Chara spp.
Nitella spp.

In water which has a *swift* current and a *sand-gravel* substratum the usual plants are:

Poa annua var. *reptans*

Potamogeton foliosus var. *genuinus* and
 var. *macellus*
Zannichellia palustris var. *major*

Water which has a *shallow* current and a *muddy* substratum generally contains:

Ludwigia palustris var. *americana*
Sagittaria latifolia
Alisma subcordatum
Callitriche heterophylla

Eleocharis acicularis and varieties
Ceratophyllum demersum
Anacharis occidentalis

From what has already been stated concerning species growing under different conditions, it is obvious that various combinations of certain environmental conditions favor the occurrence of some species, or an assemblage of species, more so than they do others.

The combination of factors least conducive to the growth of aquatic spermatophytes is very swift and deep water at the head of a large spring. In such outlets of subterranean streams, water rushes out by the gallon, and the plants usually can not get a foothold in such swiftly rushing water. Passing through various stages of more favorable habitats, the one apparently best suited to a luxuriant production of aquatic plant life is that containing a combination of water which is slightly deep, having a slow to medium current, or at least with some current producing a visible motion, together with a sandy-mud or muddy gravel substratum. Too much sand or too much mud eliminates the occurrence of either mud-loving or sand-loving species, while sand-mud or mud-sand-gravel mixtures appear to be favorable media for the growth of all the species.

Sometimes it is hard to explain why some springs, apparently with the necessary qualifications of favorable environmental factors, appear to be unsuited for the growth of a variety or luxuriance of plants. Some of the springs most favorable for a rich development of aquatic plants are Boze Mill Spring in Oregon County, Big Spring in Carter County, Double or Rainbow Spring in Ozark County, and Bennett Spring in Laclede County.

Some of the species found in the springs are those which require a cool temperature of 54°–60° F.; they are not found in waters with warmer temperatures. The following species are exclusively restricted to spring waters or waters in the vicinity of outlets of springs:

Sparganium americanum
Potamogeton amplifolius
Potamogeton foliosus var. *genuinus*
Potamogeton foliosus var. *macellus*
Potamogeton lucens

Lemna trisulca
Ranunculus longirostris
Rorippa Nasturtium-aquaticum
Myriophyllum heterophyllum
Veronica connata and var. *glaberrima*

Other species which are found in springs are far more tolerant of a range in temperature, for these occur not only in the cooler waters of the springs, but even in the warmer waters of ponds or rivers. Some of the water in these ponds reaches temperatures above 80° F. The species tolerant of this range in temperature are:

Najas guadalupensis
Eleocharis acicularis var. *typica*
Spirodela polyrrhiza
Lemna valdiviana
Wolffia punctata
Polygonum hydropiperoides

Callitriche heterophylla
Peplis diandra
Ludwigia palustris var. *americana*
Myriophyllum scabratum
Myriophyllum proserpinacoides
Utricularia gibba

Of these, the ones that occur most commonly in the springs and in the warmer ponds are *Eleocharis acicularis* var. *typica*, *Callitriche heterophylla*, and *Ludwigia palustris* var. *americana*. It is interesting

to note that all three of these species root in shallow water along the margins of the ponds where the water may reach over 80° F., as well as along the shallow margins of the colder water of the spring heads and spring branches.

DIFFERENTIATION AND DISTINGUISHING CHARACTERS OF SPECIES

The purpose of the present section is to give some of the characteristics of each species occurring in or marginal to the water of the various Ozark springs. Technical descriptions of all these species are found in manuals and monographs, so that in the present case only the most obvious field marks for identification are given.

Differences in the habitats of these species have already been discussed, and it is obvious that some species prefer fast to still water, deep to shallow water, and sand to mud substratum.

Aside from differences in habitat, there remain for discussion differences in habit, color, and general appearance due to such factors as leaf arrangement and leaf position. As regards the habit of the plant, some species grow with erect stems, while others have a decumbent, procumbent, or even prostrate habit. Also, some species grow more or less as solitary individuals, while others generally occur in colonies.

The following species usually occur as solitary plants:

Alisma subcordatum
Poa annua var. *reptans*
Juncus macer
Juncus effusus var. *solutus*
Ceratophyllum demersum
Callitriche heterophylla

Peplis diandra
Rotala ramosior var. *interior*
Ludvigia palustris var. *americana*
Epilobium coloratum
Myriophyllum scabratum
Lindernia dubia var. *typica*

The following grow generally in colonies or mats of several plants close together:

Typha latifolia
Sparganium americanum
Potamogeton crispus
Potamogeton amplifolius
Potamogeton lucens
Potamogeton foliosus var. *genuinus*
Potamogeton foliosus var. *macellus*
Potamogeton panormitanus var. *major*
Potamogeton panormitanus var. *minor*
Najas guadalupensis
Zannichellia palustris var. *major*
Anacharis occidentalis
Eragrostis hypnoides
Leersia oryzoides
Eleocharis acicularis var. *typica*
Eleocharis acicularis var. *gracilescens*
Eleocharis calva

Spirodela polyrhiza
Lemna trisulca
Lemna valdiviana
Wolffia punctata
Heteranthera dubia
Juncus acuminatus
Saururus cernuus
Polygonum hydropiperoides
Nuphar ozarkanum
Ranunculus longirostris
Rorippa Nasturtium-aquaticum
Cardamine bulbosa f. *fontinalis*
Myriophyllum heterophyllum
Mentha piperita
Veronica connata
Utricularia gibba

Most of the species in the above list have creeping rootstocks.

The following species usually have a prostrate or procumbent habit of growth:

Zannichellia palustris var. *major*
Anacharis occidentalis
Poa annua var. *reptans*
Eragrostis hypnoides
Heteranthera dubia

Ludvigia palustris var. *americana*
Myriophyllum scabratum
Myriophyllum proserpinacoides
Veronica connata

The species in the above list generally grow with a procumbent or prostrate habit. One factor responsible for this habit is the swift, shallow water in which some of them, such as *Poa annua* var. *reptans*, *Zannichellia palustris* var. *major*, and *Veronica connata* grow. Also, the tendency of some species to creep along wet, muddy places at the edge of the spring accounts for the prostrate habit often found in *Ludvigia palustris* var. *americana*, *Heteranthera dubia*, *Anacharis occidentalis*, *Eragrostis hypnoides*, *Myriophyllum proserpinacoides*, and *Myriophyllum scabratum*.

Fast, shallow water usually causes normally erect-growing plants to become prostrate or procumbent, and this is quite marked in the case of several species of *Potamogeton*, *Polygonum hydropiperoides*, *Ranunculus longirostris*, and *Eleocharis acicularis* var. *typica*. These species grow in both still and swift waters, and their habits of growth vary according to their toleration of one or the other type of current.

While some species occur in definite colonies of several to many stems or plants growing together, their appearance differs considerably as a result of the manner of growth. Some of them, such as species of *Chara* and *Nitella*, grow in large, hemispherical masses, the shape a result of the regular growth in all directions. *Ranunculus longirostris* generally occurs in circular or subcircular masses, because of its branching and growth in all directions. *Rorippa Nasturtium-aquaticum*, likewise, forms dense, evenly grown clumps of foliage.

On the other hand, some species have the habit of elongating the stem-axes in one direction and producing leaves mostly in two planes. This type of vegetative growth, especially when the main stem produces few branches, results in long strands of foliage. Such is the case in *Potamogeton lucens* and *P. foliosus* var. *genuinus*, whose elongate, mostly simple stems grow to three and four feet in length. *Najas guadalupensis*, with a similar growth habit, produces long, dense mats, sometimes five or even ten feet long. *Zannichellia palustris* var. *major*, *Heteranthera dubia*, and *Anacharis occidentalis* sometimes form long, vegetative strands. Under certain conditions, where the water is shallower or swifter, these same species may produce

much shorter stems with shorter internodes, thus becoming less elongated, and, consequently, forming denser and more circular patches.

Both *Eleocharis acicularis* var. *typica* and *E. calva* form large beds or colonies because of their creeping rootstocks, and the same result is found in the case of *Sparganium americanum*, *Mentha piperita*, and many other plants. Some species, such as *Mentha piperita* and *Eleocharis acicularis*, form dense colonies along the shallow stretches of spring water, but can not tolerate too great a depth, and eventually their colonizing and rooting tendencies become lost in direct proportion to the increasing depth of the water.

Differences between the various species in color is well marked and in general is a good specific character for field identification. Of course, some of the species have a slight change in color according to the season of the year, but in general the color for any one species remains a fairly constant and reliable character. Thus, *Callitriche heterophylla* is usually a shade of light green, or rarely assumes a bronze or coppery appearance with a light green tint, but the light green color is quite characteristic. *Rorippa Nasturtium-aquaticum* remains constant in color throughout the year; it is usually of a light green or rich grass-green shade. *Sparganium americanum* always has pale to light green leaves. *Zannichellia palustris* var. *major* usually has leaves of a light green color, but is also of a bright green, rich or dark grass-green color, and sometimes appears blue-green. *Eleocharis acicularis* and varieties are usually of a light or grass-green shade similar to the usual color of *Zannichellia palustris* var. *major*. *Eleocharis calva*, on the other hand, together with *Juncus acuminatus* and *Juncus effusus* var. *solutus*, has dark or dull green leaves and stems. *Cardamine bulbosa* has leaves of a light green color on the upper surface, and either purplish or pale green on the lower surface. *Veronica connata* and variety are fairly uniform, most constantly appearing in shades of olive-green. These shades may vary at times from a dull olive or pastel-olive to olive-green, light green, or sometimes, in late fall and winter, to an olive-green tinged with a brick color. *Najas guadalupensis* varies from a rich grass-green to dull green or brownish green, and even to brownish. Its usual color is a dull grass-green.

The various species of pondweeds found in springs and spring branches are usually in shades of dark green. *Potamogeton crispus* is the darkest green of any of the species, and often is green-brown in color. *Potamogeton amplifolius* is either dark blackish green, dull,

dark green, or dull green. *Potamogeton lucens* is usually dull olive-green, but varies from light green to an olive-green, grass-green, dark olive, or even buff-brown color. The varieties of *Potamogeton foliosus* are quite variable in color. In his key to the varieties of *Potamogeton foliosus*, Fernald¹ distinguishes var. *genuinus* from var. *macellus* partly on the basis of color. *Potamogeton foliosus* var. *genuinus* is characterized by "leaves deep-green to bronze," while *P. foliosus* var. *macellus* is distinguished by "leaves bright green." After having made many collections in Missouri of both these varieties, I find that these color differences are not constant. For example, I have found *Potamogeton foliosus* var. *genuinus* in Missouri with the following colors: bright green, dark green, bright olive-green, dark bronze-green, and brown-black-green, while *P. foliosus* var. *macellus* has the following variations: dark bronze, olive-green and bronze, bronze-green, dark green and bronze, and dull green. In the majority of cases it was found that *P. foliosus* var. *genuinus* was usually a bright green color, while *P. foliosus* var. *macellus* was either dark green, bronze-green, or a combination of dark green and bronze. In many instances it was found that both varieties occurred near each other, and sometimes side by side. In fact, while *Potamogeton foliosus* var. *genuinus* is more frequently found in deeper or fast-flowing water, and *P. foliosus* var. *macellus* oftener in shallower and slower water, the habitats of the two types merge, and at times it is difficult to determine material which agrees absolutely with the characters assigned by Fernald to one or the other variety. In one spring *P. foliosus* var. *genuinus* assumes the "deep-green to bronze" color by which Fernald characterizes it, while in other springs the same variety may be found with leaves "bright green," which is supposed to distinguish the other variety, *P. foliosus* var. *macellus*.

Of the aquatic grasses found in spring waters *Poa annua* var. *repens* and *Agrostis stolonifera* usually have blue-green or silvery green leaves. These are the most common of the more frequent aquatic grasses.

Ranunculus longirostris is usually of a grass- or dark green color, but varies from an olive-green to a dark blackish green color. The aquatic, submerged states of *Polygonum hydropiperoides*, which grow in dense mats similar to those of *Veronica connata*, often resemble that species in color, usually possessing an olive-green color, but they are usually flushed with purple and red shades. It often has leaves of a bronze-purple color on the lower surface and an olive-green on the

¹ M. L. Fernald, The linear-leaved North American species of *Potamogeton*. Mem. Amer. Acad. 17: 43. 1932.

upper surface. The leaves may be mostly tinged with reddish or copper in some specimens and orange and green in others.

The thin, submerged leaves of *Nuphar ozarkanum* are usually olive- or light green tinged with pink-reddish or bronze color, while the floating leaves are leathery and dark green. *Heteranthera dubia* also usually has leaves of an olive-green color. In *Ludvigia palustris* var. *americana*, while the ordinary color scheme is a combination of various reds or coppery-reds and greens, as in *Polygonum hydro-piperoides*, other shades also are found, such as olive-green with rose or copper color, brownish red and green, and olive-green with the tips of the shoots red and orange or tinged with bronze and orange. Rarely is the entire plant of a reddish purple color. Sometimes the leaves are all dark green in shade, but usually some reddish, purplish, or orange color is suffused with the olive-green. At times, in winter, many leaves of some of the plants become darker, or most of them become black, with only the tips remaining colored.

Passing to the darker shades of green found among the species inhabiting springs, we find that the commoner ones having a dark green color are *Ceratophyllum demersum*, *Anacharis occidentalis*, and *Myriophyllum heterophyllum*. In *M. heterophyllum* the plants are usually dark green, but vary greatly according to the season of the year and depth of the water. Sometimes plants of this species are of a bronzed-red, or purple-red color. In winter they are often brown-red or even brown, but this is not always the case, for in some springs in winter the plants may be more green than brown. A bronze tinge is characteristic of many plants of this species at certain times of the year. In spring the plants are often dark green. In great depths of water, such as at Markham Spring in Wayne County, the stems of *M. heterophyllum* may be entirely purple-red. *M. scabratum*, a rarer species, usually has dark green or grass-green leaves, while a tropical species, *M. proserpinacoides*, introduced and established around Blue Spring in Crawford County, has leaves of a blue-green or gray-green color. Another common species with a dark color is *Ceratophyllum demersum*. It usually is dark green, but varies from dark bronze-green to bronze and purple and even dark brown with blackish green. *Anacharis occidentalis* is most frequently dark grass-green. It often gives a black appearance to the water when it occurs in large masses. It is often found with *Myriophyllum heterophyllum*, and where the two are close together, with a similar dark green or blackish green color, the differentiation of the two plants may be made at some distance by the smaller, more terete or pencil-shaped, smoother masses of

Anacharis, compared with the broader, more worm-like or bushy-tailed appearance of *Myriophyllum heterophyllum*. The latter is sometimes called coon's-tail, in allusion to the bushy-tailed appearance of its large strands. *Anacharis* also appears in other colors, such as coppery, dark coppery green, dull green mixed with red, and russet-brown and green. The latter color combination was observed in some places during the spring season. *Alisma subcordatum* usually has dark green leaves, as has also *Peplis diandra*, and *Saururus cernuus*. *Peplis diandra* may assume shades of rose or orange when exposed to bright, steady sunlight. *Chara* and *Nitella* species are frequently dark green, but also vary considerably. In some species of *Chara* the color may usually be dull olive-green or it may be dark green or dark grass-green. In species of *Nitella* the color is usually dark green, but may vary from light green to olive- and gray-green.

Among the Lemnaceae of spring waters, most species of *Lemna*, *Wolffia*, and *Spirodela* are of light to grass-green shades. The exception is *Lemna trisulca*, which is usually dark blue-green.

Utricularia gibba most often occurs in light to olive- or grass-green mats, but *Meniha piperita* is characteristically grass-green.

The various types of leaf arrangement serve to distinguish many of the species occurring in the spring and give them their characteristic appearance.

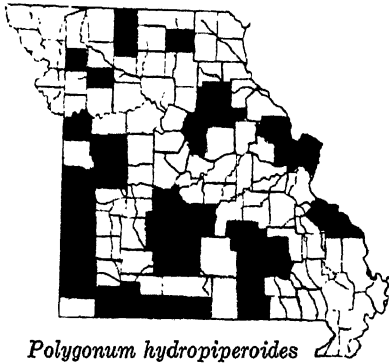
GEOGRAPHICAL DISTRIBUTION OF SPECIES

The species discussed below are those which are either characteristic of the spring, that is, they are the ones found the greatest number of times among the species occurring in the spring water, or they are species usually found in springs. This list includes the following species:

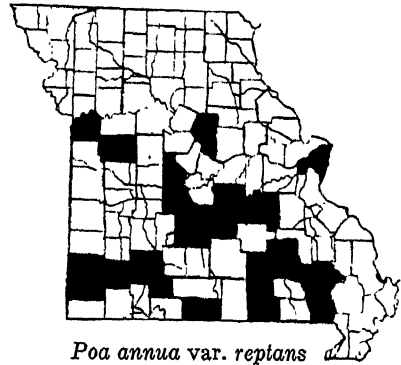
Sparganium americanum
Potamogeton amplifolius
Potamogeton lucens
Potamogeton crispus
Potamogeton foliosus var. *genuinus*
Potamogeton foliosus var. *macellus*
Potamogeton panormitanus var. *major*
Potamogeton panormitanus var. *minor*
Zannichellia palustris var. *major*
Anacharis occidentalis
Poa annua var. *replans*
Eleocharis acicularis var. *typica*

Eleocharis acicularis var. *gracilescens*
Lemna trisulca
Wolffia punctata
Polygonum hydropiperoides
Rorippa Nasturtium-aquaticum
Cardamine bulbosa f. *fontinalis*
Ceratophyllum demersum
Ranunculus longirostris
Callitriche heterophylla
Ludvigia palustris var. *americana*
Myriophyllum heterophyllum
Veronica connata and var. *glaberrima*

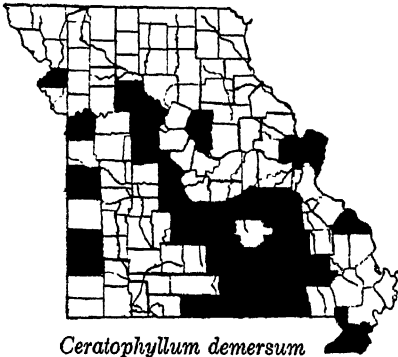
Species not included in the above list are ones which either are not found typically in springs or spring water but occur in many



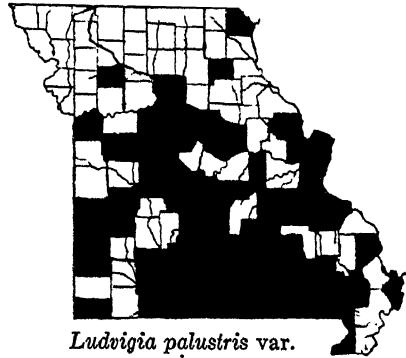
Polygonum hydropiperoides



Poa annua var. *reptans*



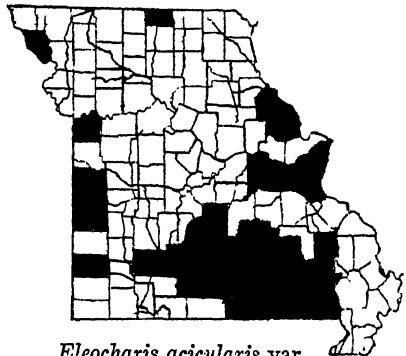
Ceratophyllum demersum



Ludwigia palustris var. *americana*

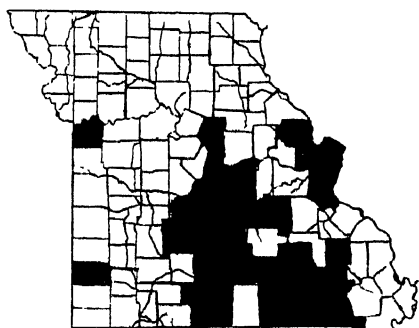


Zannichellia palustris var. *major*

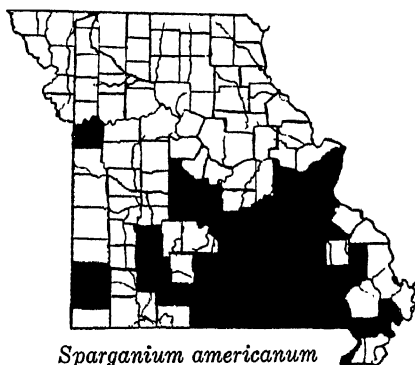


Eleocharis acicularis var. *typica*

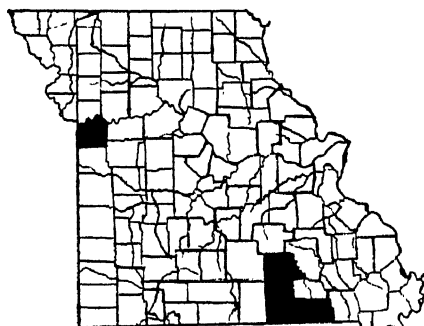
FIG. 46. Distribution in Missouri of the species of the fresh-water springs.



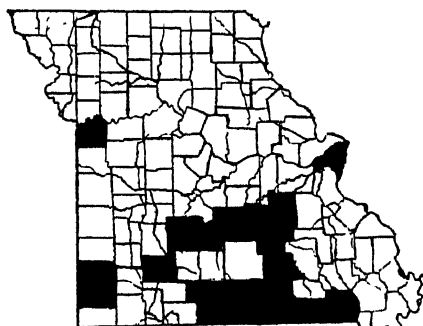
Anacharis occidentalis



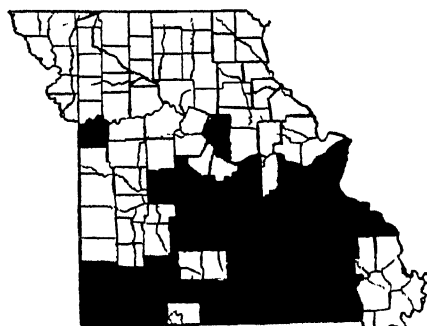
Sparganium americanum



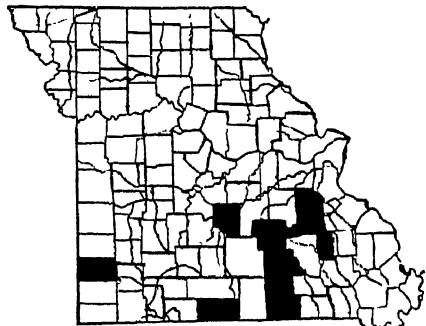
Lemna trisulca



Ranunculus longirostris



Rorippa Nasturtium-aquaticum



Cardamine bulbosa f. fontinalis

FIG. 47. Distribution in Missouri of the species of the fresh-water springs.

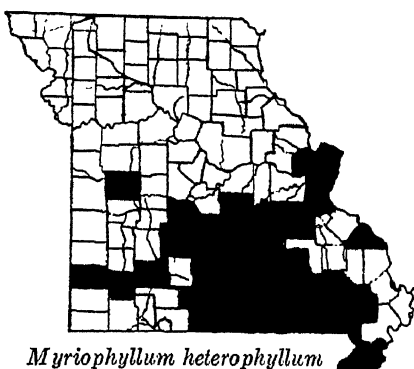
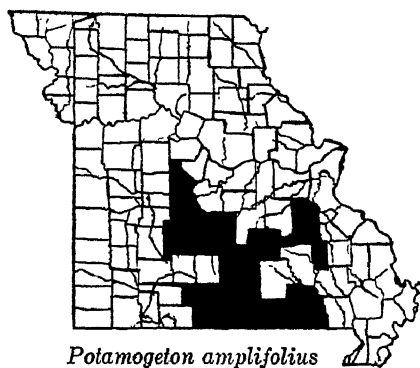
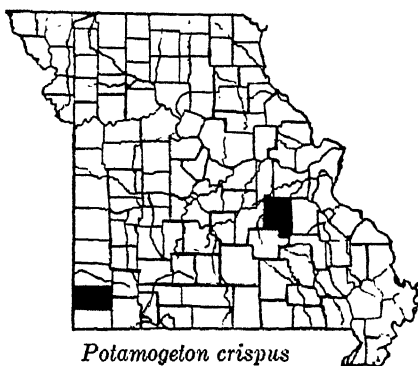
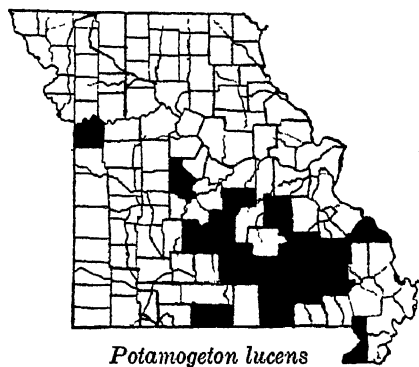
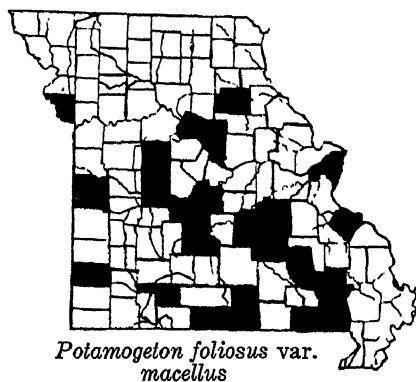
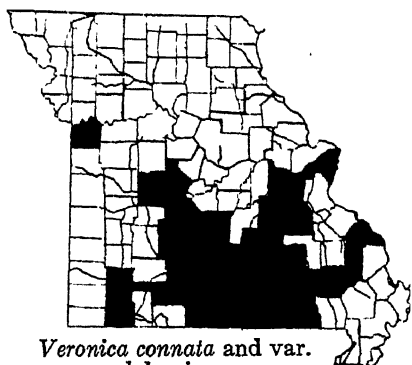


FIG. 48. Distribution in Missouri of the species of the fresh-water springs.

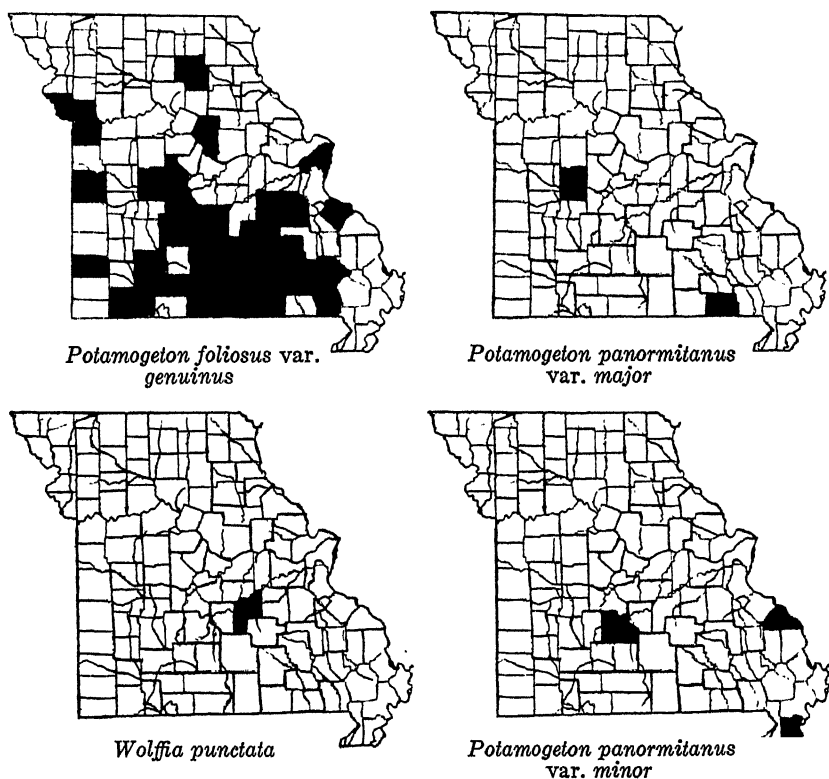


FIG. 49. Distribution in Missouri of the species of the fresh-water springs.

other types of habitat, or else are species which occur only casually in or around spring water. On the other hand, all the species listed above are typically found in spring water in Missouri or are found for the most part inhabiting this kind of water.

It is interesting to note the distribution in Missouri of the species mentioned above which occur in the springs. The distribution of these species by counties as shown in figures 46–49 reveals the fact that more than half of them (59 per cent) are limited to the Ozarks, and one-third of them are mostly general throughout Missouri, although three of these, namely, *Eleocharis acicularis* var. *typica*, *Ceratophyllum demersum*, and *Zannichellia palustris* var. *major*, are predominantly Ozarkian in distribution, and the others are chiefly Ozarkian, while two of the species in the list, or 9 per cent, are extremely local and both occur within the Ozark region. The following table analyzes these differences:

DISTRIBUTION OF SPECIES IN MISSOURI CHARACTERISTIC OF OZARK SPRINGS

Limited to Ozarks in Missouri

Potamogeton foliosus var. *macellus*
Potamogeton amplifolius
Potamogeton crispus
Potamogeton lucens
Veronica connata and var. *glaberrima*
Myriophyllum heterophyllum
Anacharis occidentalis
Sparganium americanum
Lemna trisulca
Ranunculus longirostris
Rorippa Nasturtium-aquaticum
Cardamine bulbosa f. *fontinalis*

General in Missouri

Polygonum hydropiperoides
Poa annua var. *replans*
Ludvigia palustris var. *americana*
Zannichellia palustris var. *major* (mainly Ozarkian)
Ceratophyllum demersum (mainly Ozarkian)
Eleocharis acicularis (mainly Ozarkian)
Potamogeton foliosus var. *genuinus* (mainly Ozarkian)

Local in Missouri

Potamogeton panormitanus var. *major*
Potamogeton panormitanus var. *minor*
Wolffia punctata

When the distribution within the United States of most of the species in the above list is studied (see figs. 50-66),¹ it will be noticed that the ranges fall within three main categories: (1) Those species that have a range more or less general throughout the United States; (2) those species that are distributed in the northern half of the United States and in Canada; and (3) those species that are predominantly in the eastern half or northeastern part of the United States. The first group includes *Ludvigia palustris* var. *americana*, *Zannichellia palustris* var. *major*, *Ceratophyllum demersum*, and *Potamogeton foliosus* var. *genuinus*. The second group of more northern types includes *Ranunculus longirostris*, *Lemna trisulca*, *P. lucens*, *P. foliosus* var. *macellus*, *P. panormitanus* var. *major* and var. *minor*, *Eleocharis acicularis* var. *typica*, *Rorippa Nasturtium-aquaticum*, and *Veronica connata*. The third group, the range of which is concentrated mainly in the eastern half or northeastern part of the United States, includes *Sparganium americanum*, *Anacharis occidentalis*, *Potamogeton amplifolius*, and *Myriophyllum heterophyllum*.

About half of these species are of northern distribution and about one-third of general distribution, while only one-fourth or one-fifth show an eastern or northeastern type of range.

It is interesting to observe that some species whose general distribution is mainly in the northern half of the United States, have their distribution in Missouri confined to the Ozark region. One would naturally expect that species found in Iowa, Minnesota, Wisconsin, Indiana, and other states to the north would occur as

¹ The data on these maps were provided by the examination of specimens from the herbaria of the following institutions: Field Museum of Natural History, Gray Herbarium, Missouri Botanical Garden, New York Botanical Garden, United States National Museum, and the University of Minnesota. To the curators of these herbaria the author is deeply grateful for the opportunity of examining specimens from the collections in their charge.

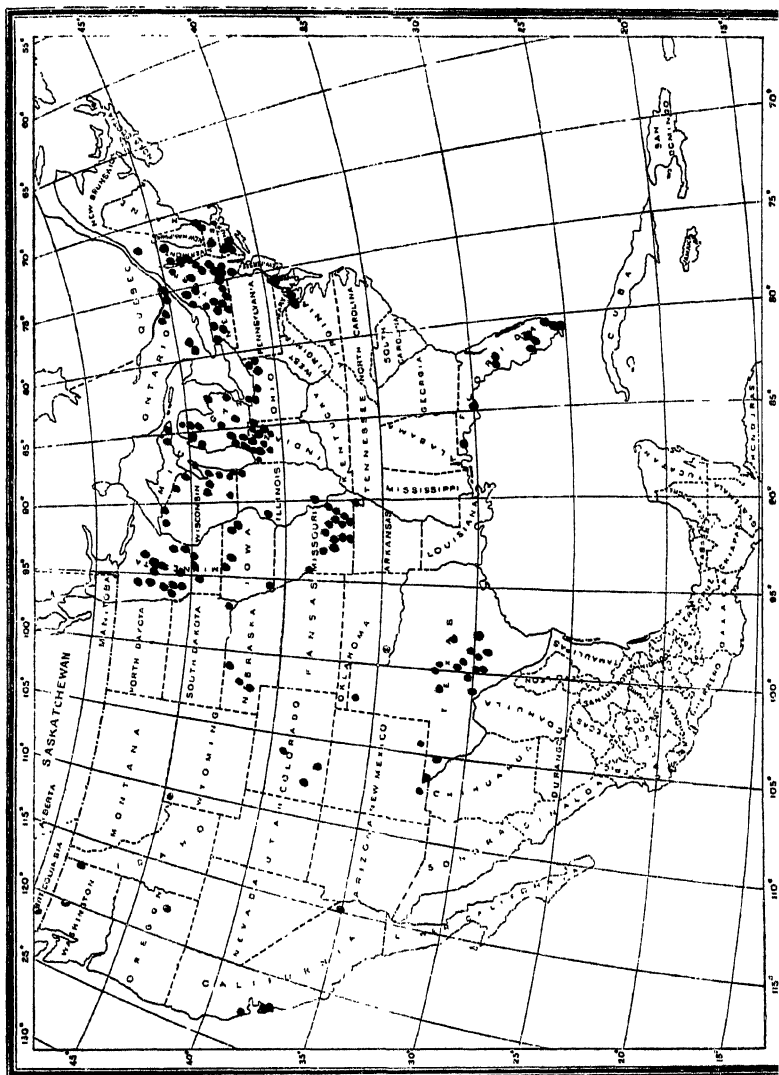


FIG. 50. Distribution of *Potamogelon lucens*. The author is deeply indebted to Dr. E. C. Ogden, of the University of Maine, who is monographing this group, for the data used in the preparation of this map.

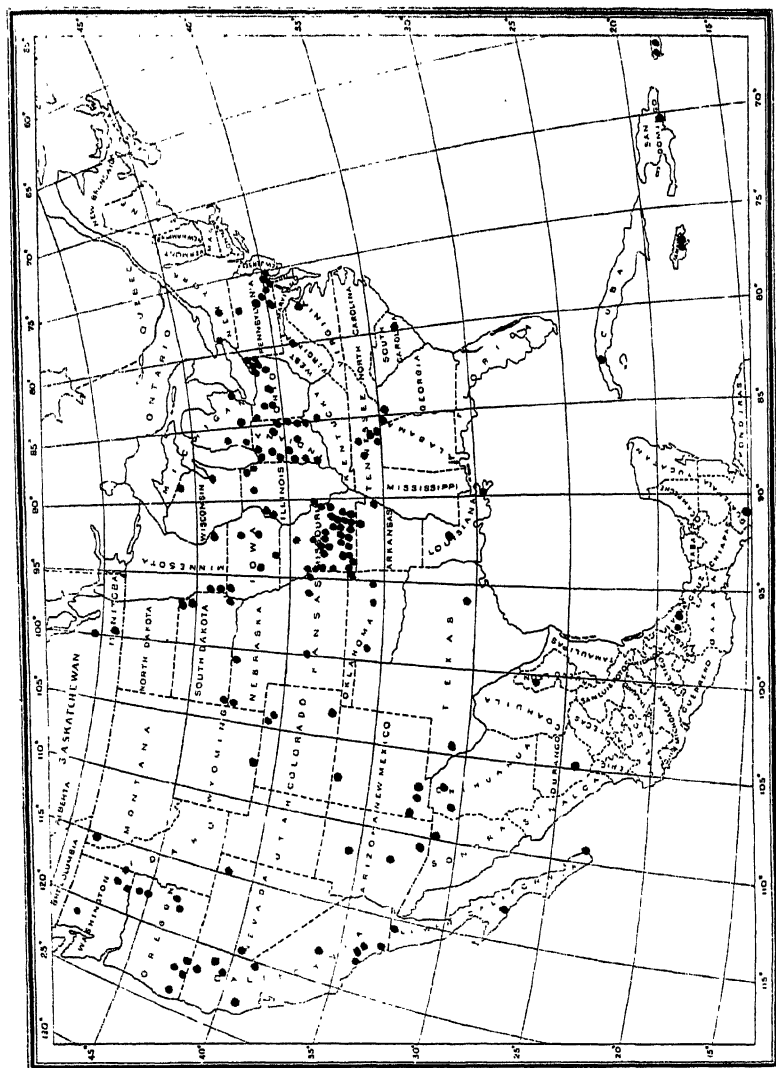


FIG. 51. Distribution of *Potamogeton foliosus* var. *genuinus*. The author is indebted to Dr. M. L. Fernald's monograph of the linear-leaved North American species of *Potamogeton* for the data used in the preparation of this map.

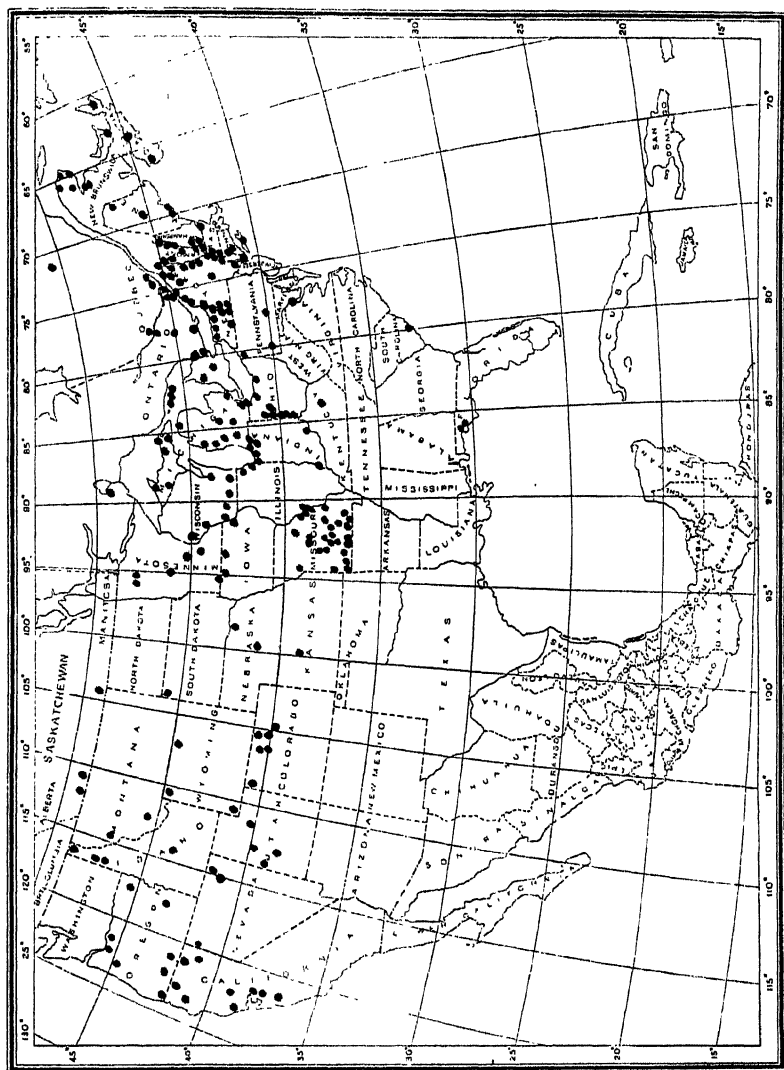


FIG. 52. Distribution of *Potamogeton foliosus* var. *macellus*. The author is indebted to Dr. M. L. Fernald's monograph of the linear-leaved North American species of *Potamogeton* for the data used in the preparation of this map.

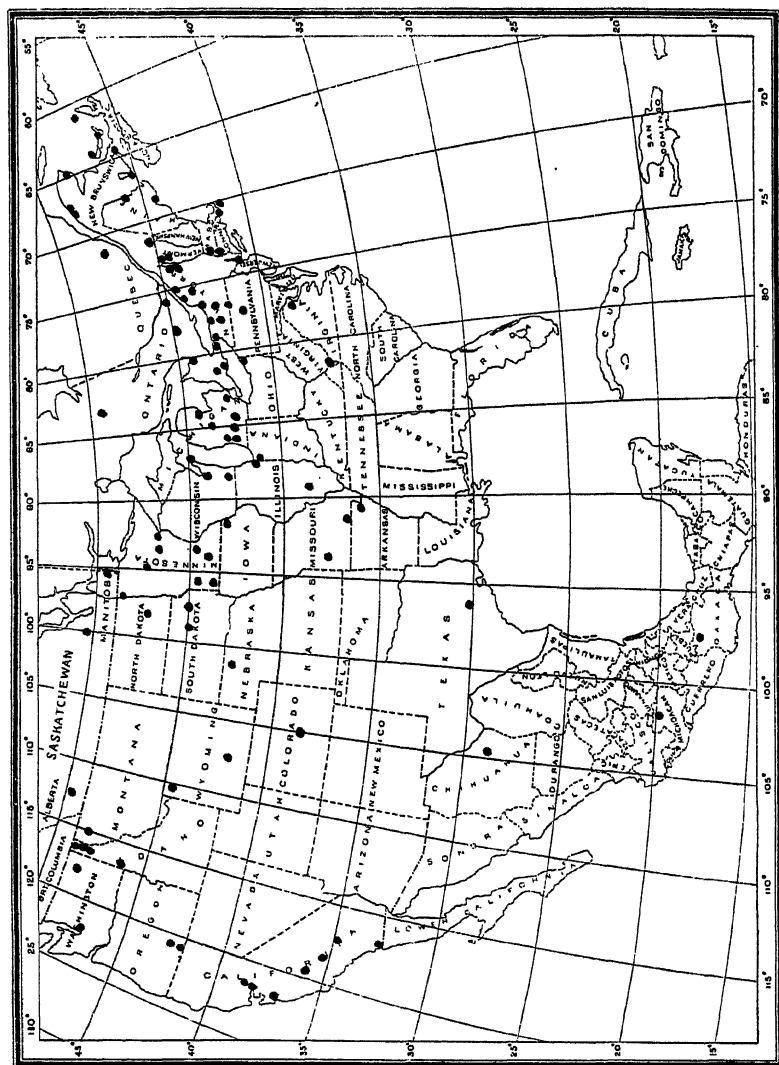
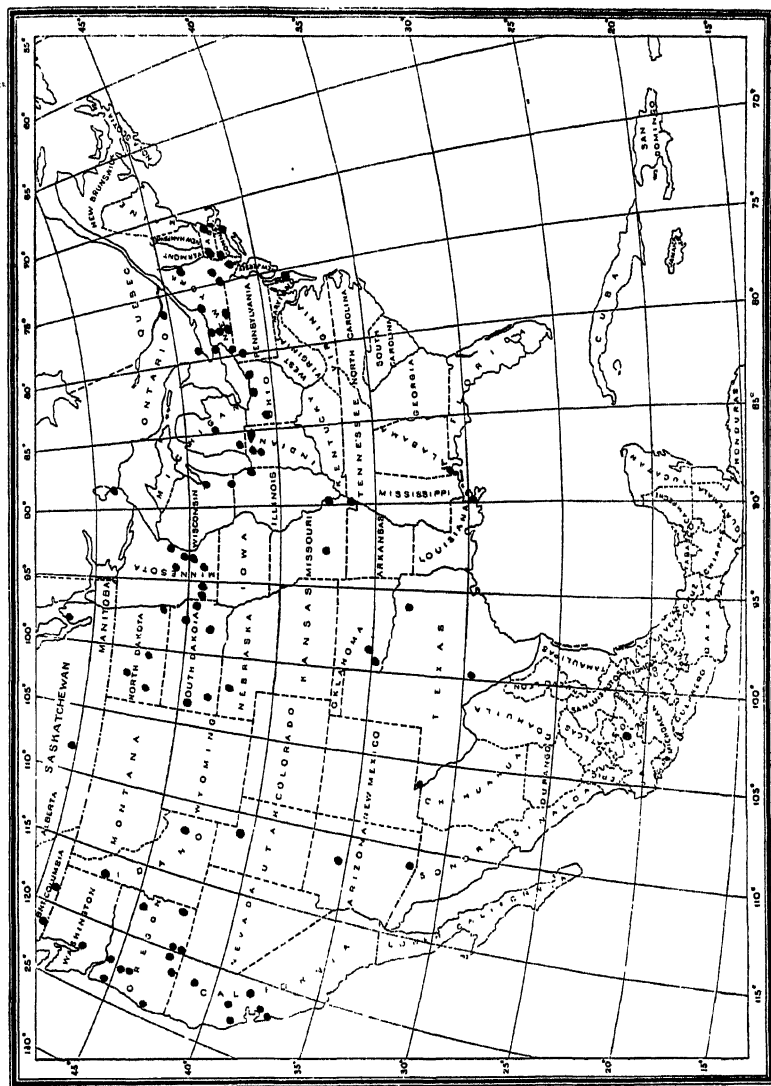


FIG. 53. Distribution of *Potamogeton panormitanus* var. *major*. The author is indebted to Dr. M. L. Fernald's monograph of the linear-leaved North American species of *Potamogeton* for the data used in the preparation of this map.



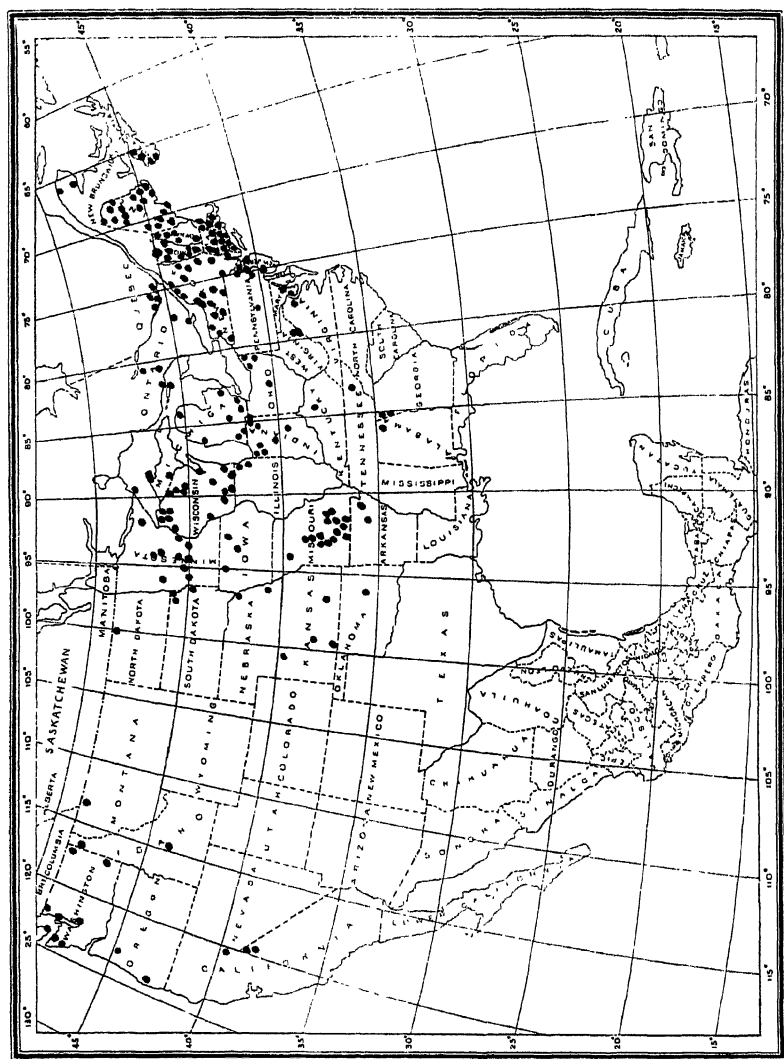


FIG. 55. Distribution of *Potamogeton amplifolius*. The author is deeply indebted to Dr. E. C. Ogden, of the University of Maine, who is monographing this group, for the data used in the preparation of this map.

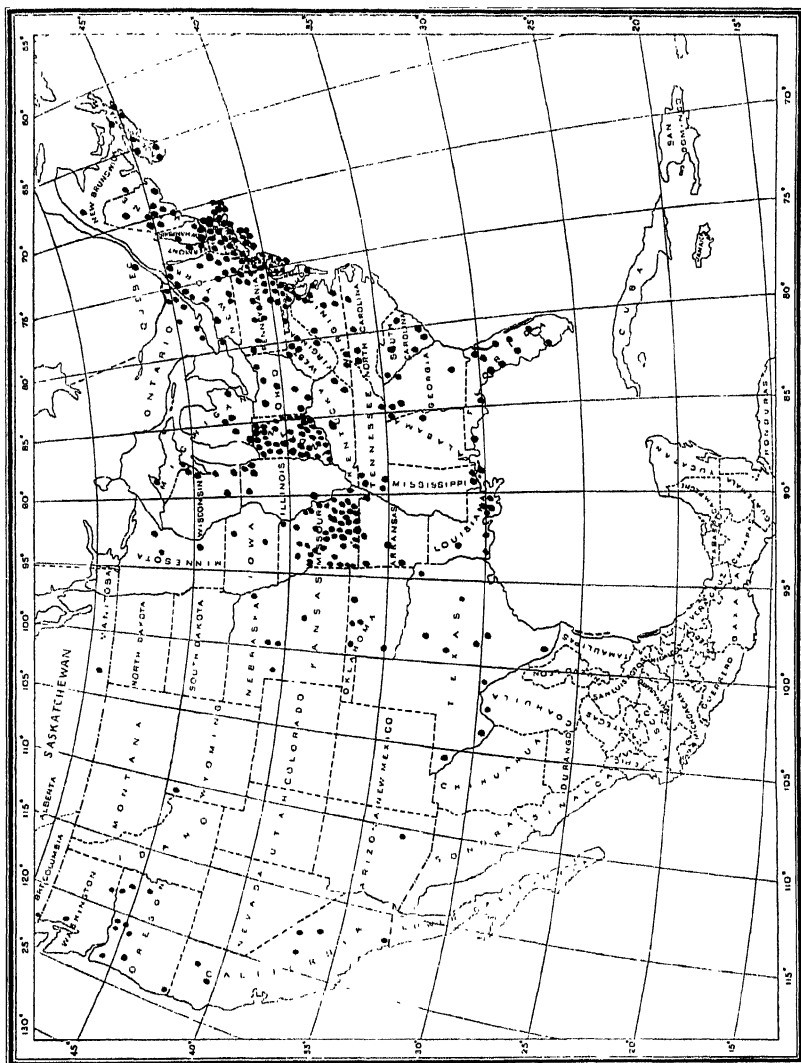


FIG. 56. Distribution of *Ludwigia palustris* var. *americana*.

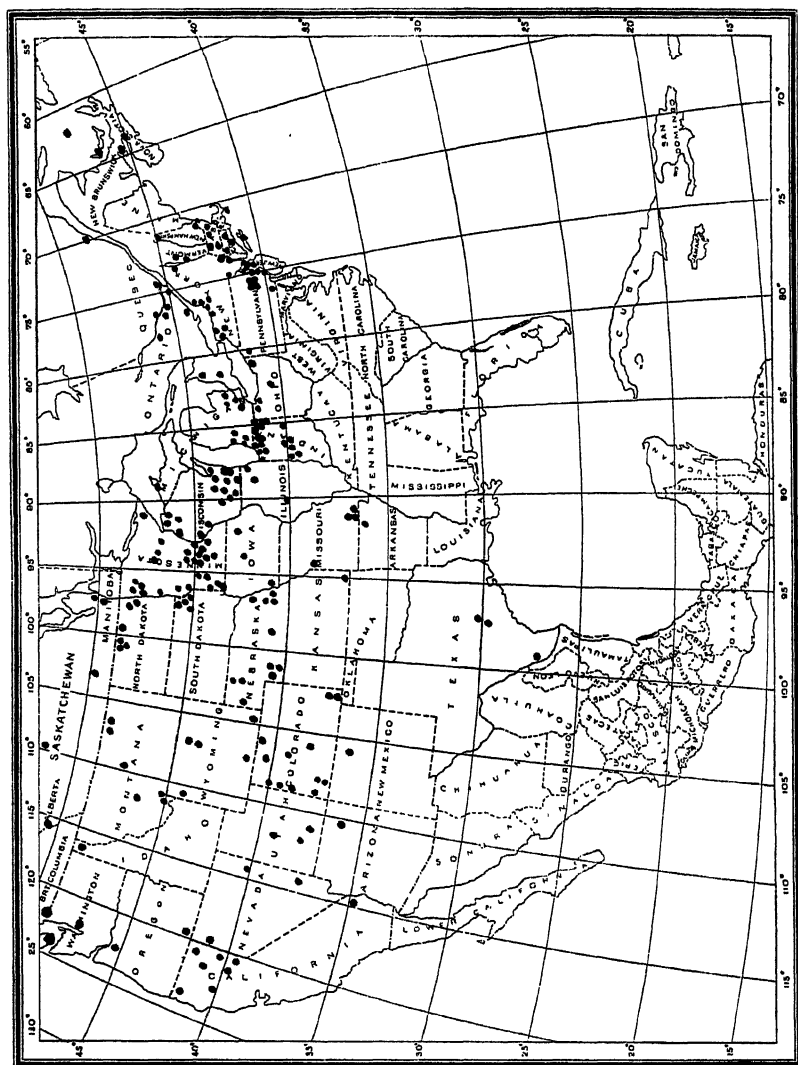


FIG. 57. Distribution of *Lemna trisulca*.

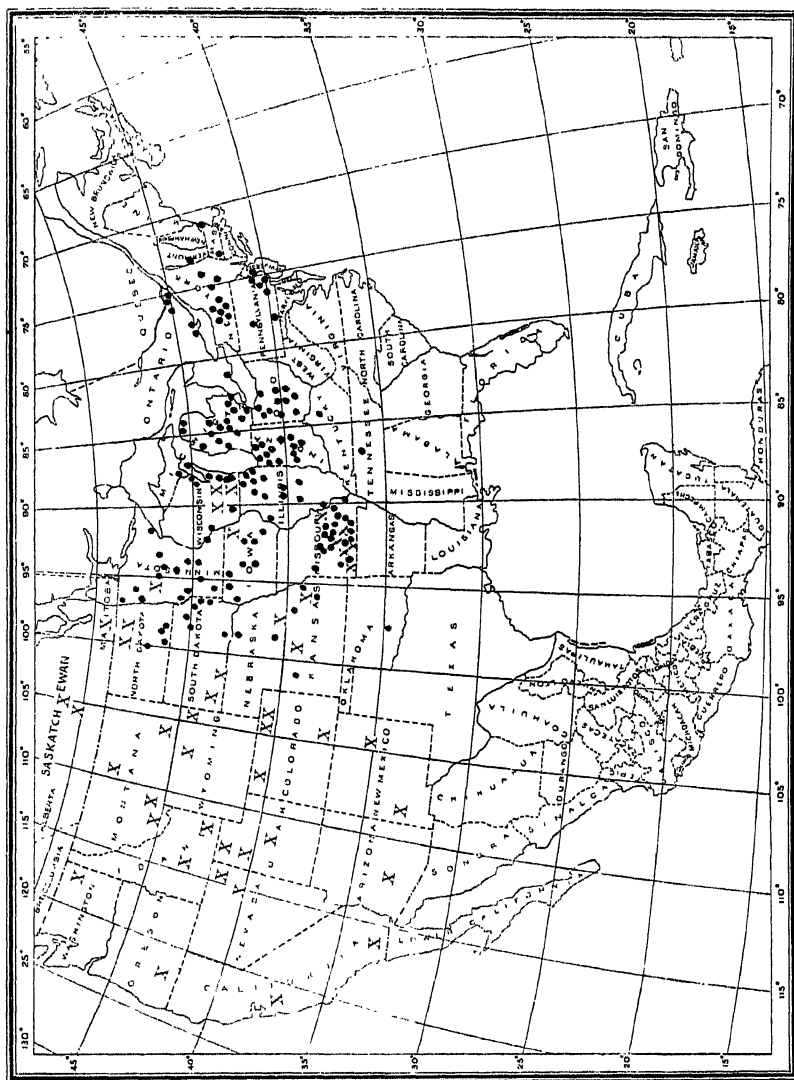


FIG. 58. Distribution of *Veronica conata* (●) and var. *glaberrima* (X).

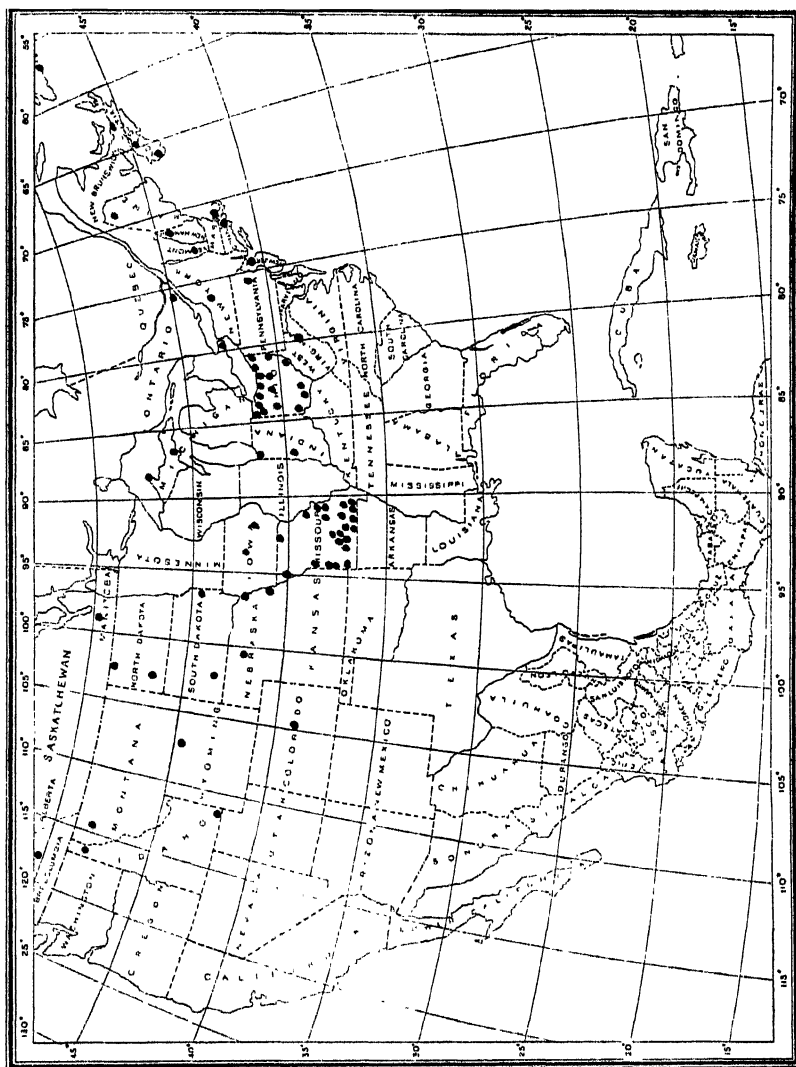


FIG. 60. Distribution of *Eleocharis acicularis* var. *typica*.

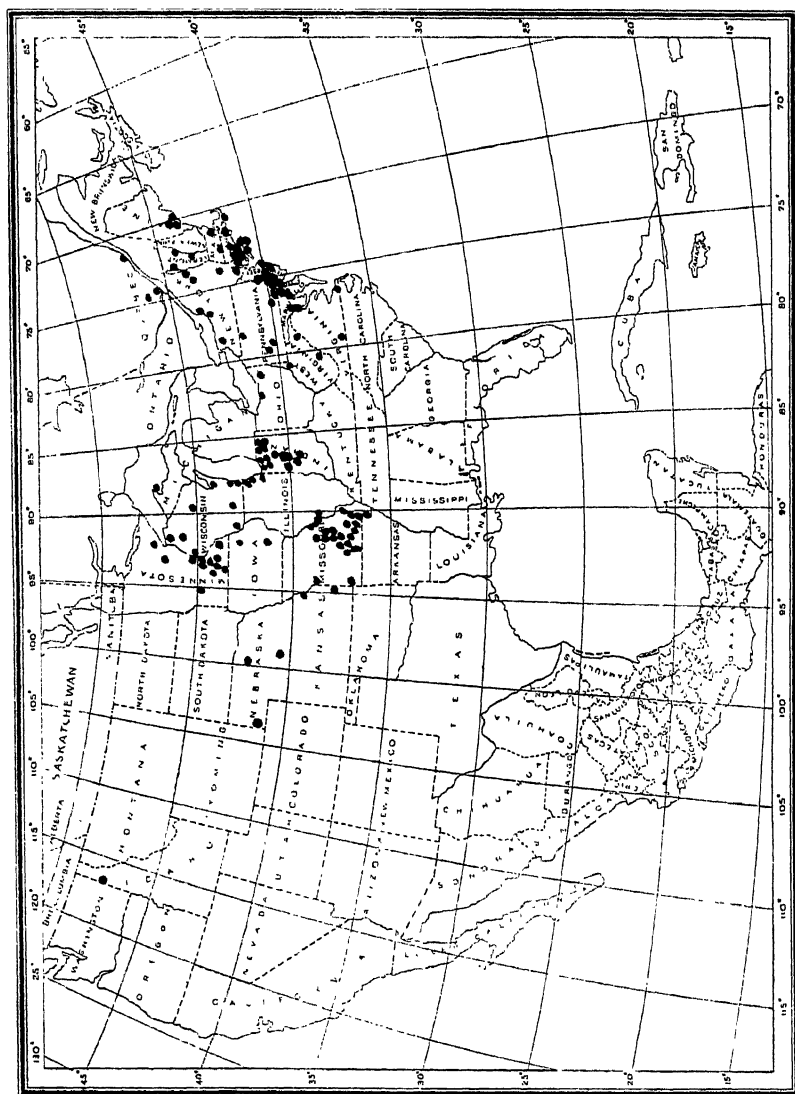


FIG. 61. Distribution of *Anacharis occidentalis*.

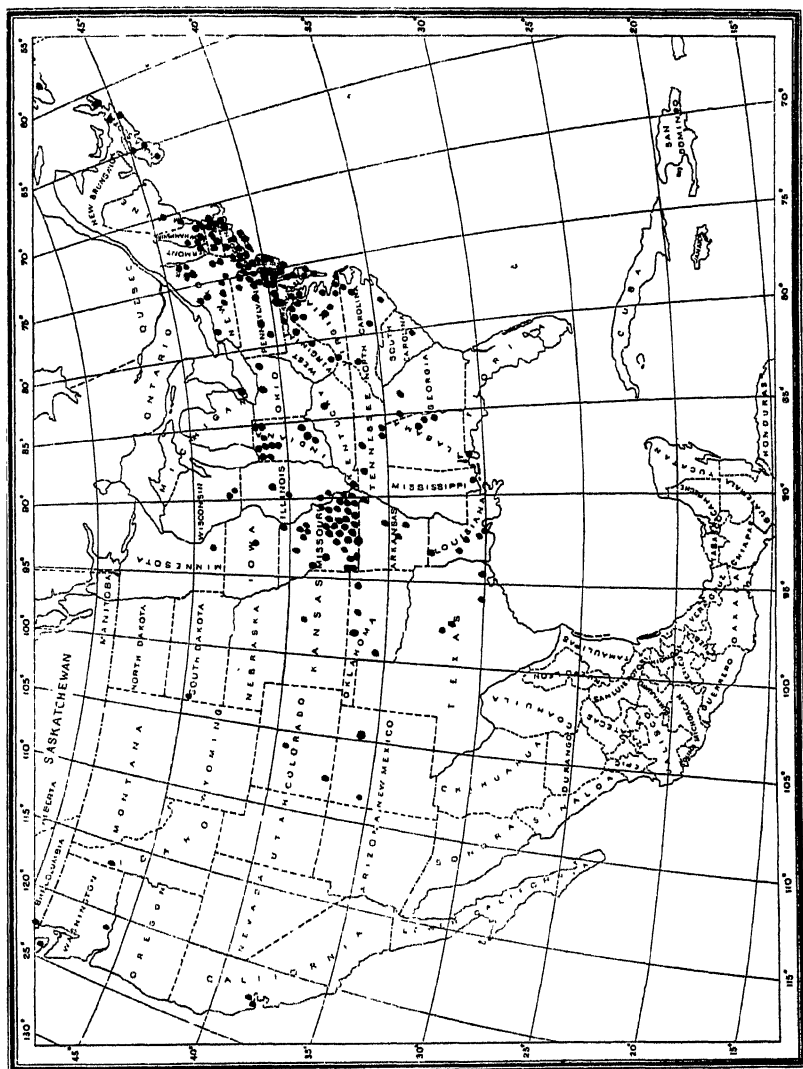


FIG. 62. Distribution of *Callitriche heterophylla*.

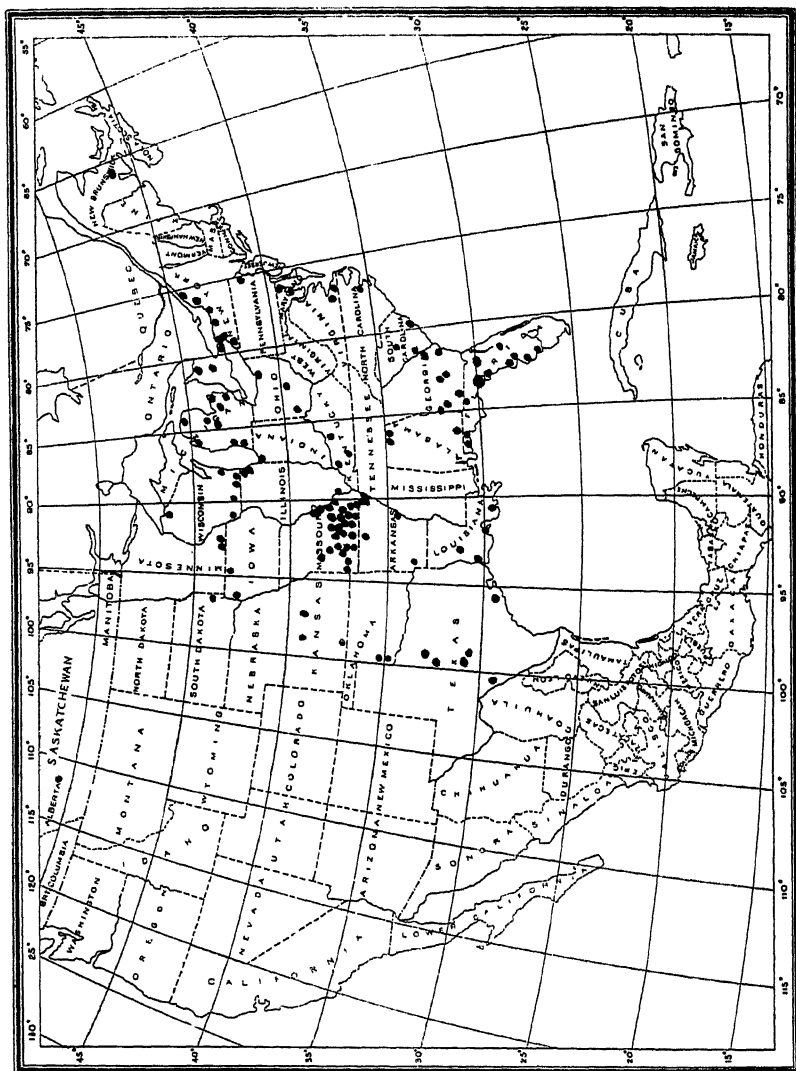


FIG. 63. Distribution of *Myriophyllum heterophyllum*.

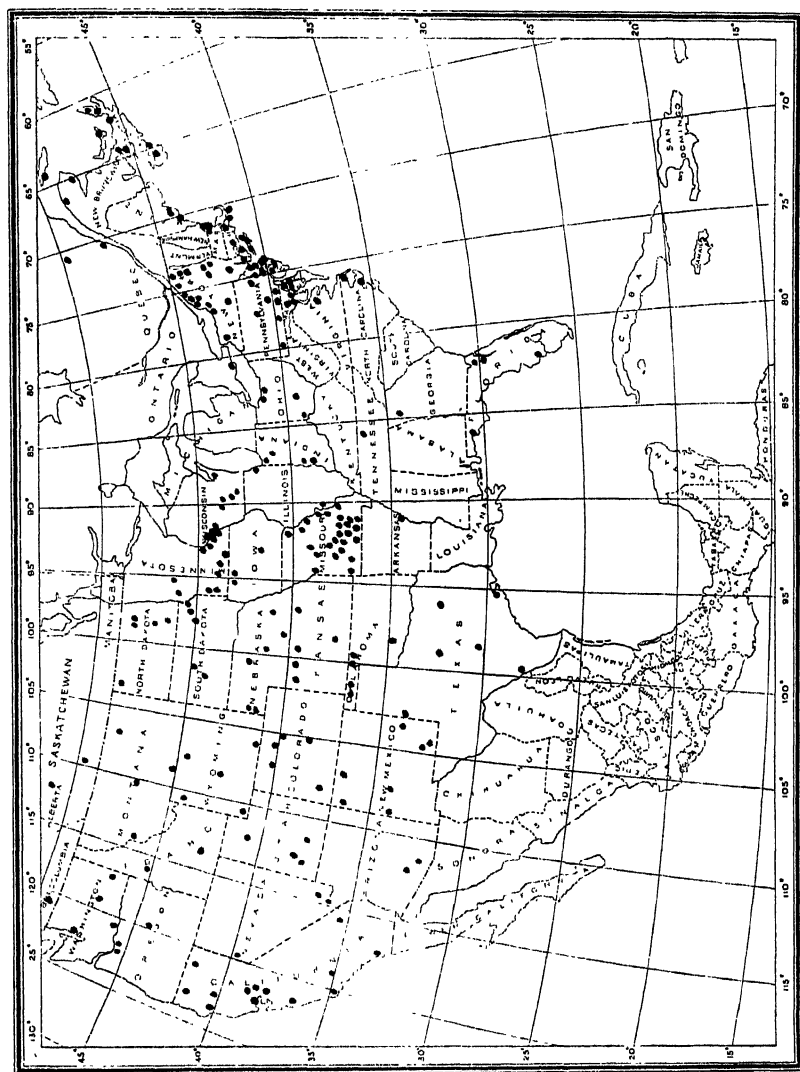


FIG. 64. Distribution of *Zannichellia palustris* var. *major*.

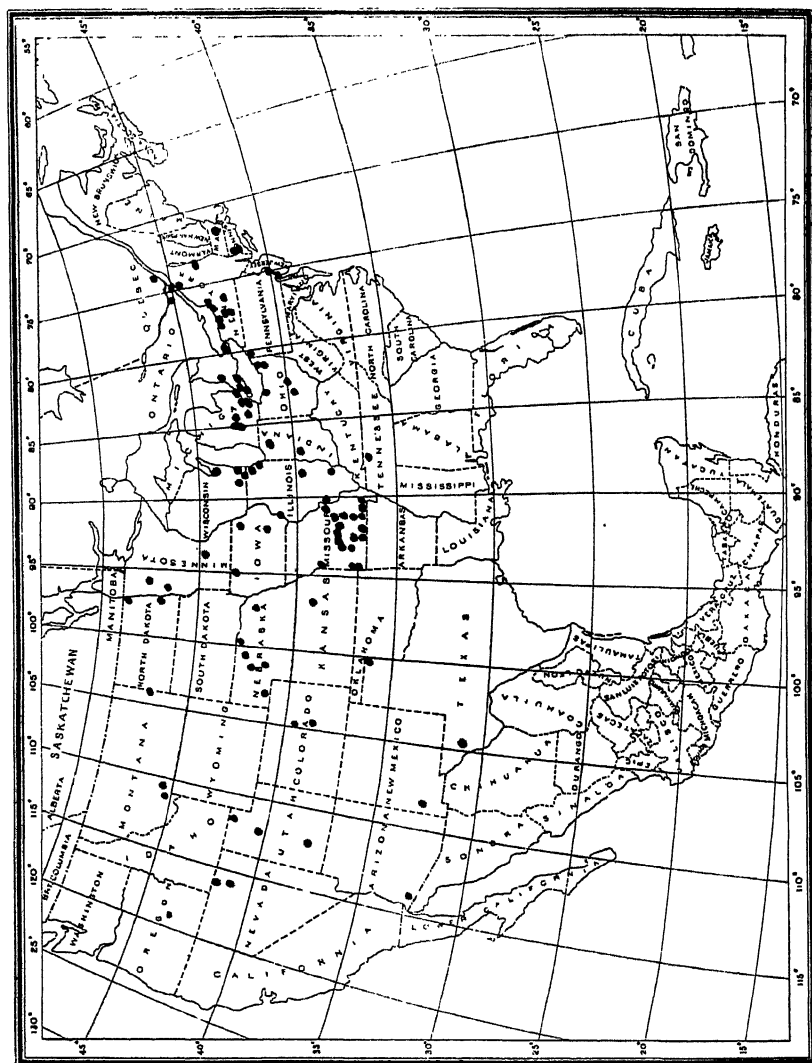


FIG. 65. Distribution of *Ramunculus longirostris*.

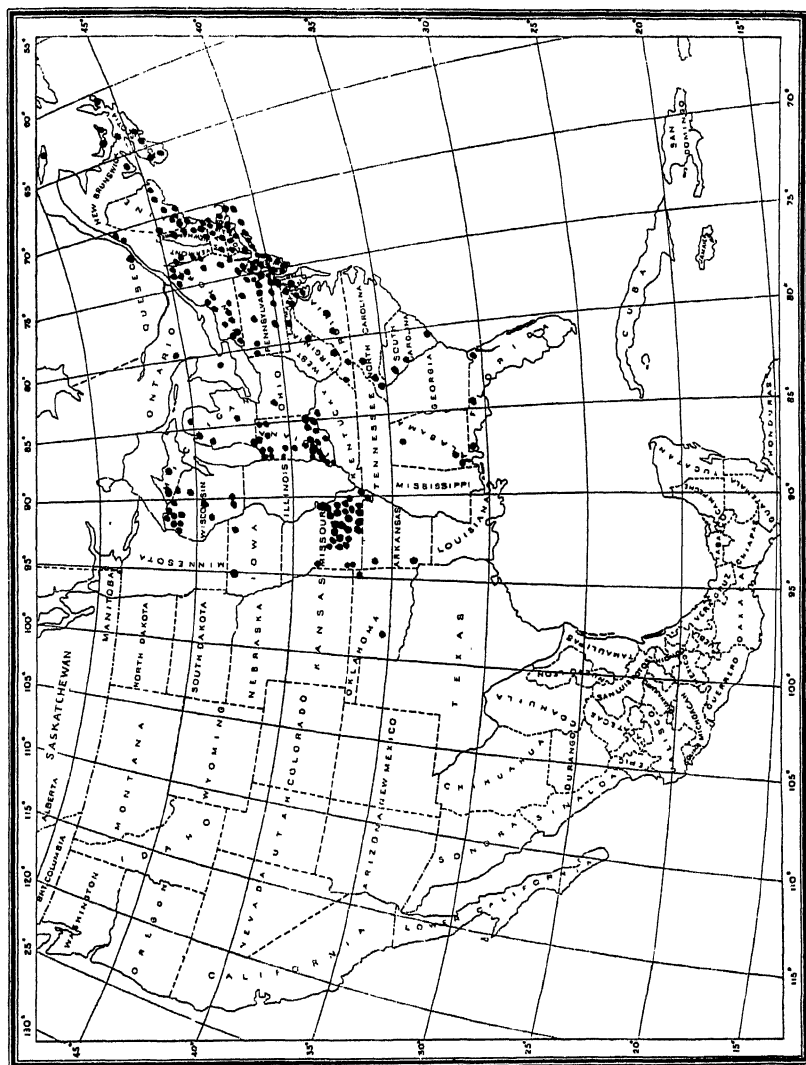


FIG. 66. Distribution of *Sparganium americanum*.

well normally in northern Missouri. Such is not the case, as may be observed from the maps which show distribution. Many of them, in fact, more than half of the species of springs, are confined to the Ozarks. This type of distribution—species which range to the north and east of Missouri but which in Missouri occur chiefly or only in the Ozark region—is not only limited to some of the species occurring within the Ozark springs; it is more or less characteristic of the distributions of many Missouri species of Ozarkian range.

In the case of the species occurring in the springs whose distribution in Missouri is confined to the Ozark region, the limiting factor appears to be the suitable habitat of cooler waters found in the Ozark springs as compared to the temperatures found in rivers, lakes, sloughs, and other types of aquatic environment in other parts of the state. All the species which in Missouri are confined, or practically confined, to the springs in the Ozarks, and yet are found north and northeast of Missouri, appear to find in the springs a suitable habitat. The only property possessed by Ozark Springs which is not duplicated in streams, lakes, sloughs, and other bodies of water in Missouri, is cold water. Other properties, such as rapid current, *pH* concentration, gravel, sand, or mud substratum, and clarity of the water, are all duplicated in other bodies of water in Missouri. Yet, as we have seen, species may be found abundantly in spring water, but are totally lacking in the slightly warmer but otherwise similar waters of the Ozark streams into which the spring water empties. This is well demonstrated in the case of Blue Spring, Shannon County. At this place *Potamogeton americanus* is found in the Current River only five feet away from the confluence of Blue Spring branch with Current River, and yet is not found in Blue Spring proper. *Potamogeton americanus* never occurs in the cool waters of the Ozark springs, but is common in the somewhat warmer waters of the Ozark streams. Conversely, species which are abundant in the cooler waters of the Ozark springs fail to reappear in the slightly warmer waters of the Ozark streams. Sometimes the cooler spring water persists for a few hundred feet down the main stream into which it empties, and as long as the influence of the cooler temperature of its water persists, so does the vegetation characteristic of the spring water. However, just as soon as this influence is lost and the water becomes warmer, the species typical of the springs likewise disappear. Water cress is so characteristic of spring water in the Missouri Ozarks that as soon as one sees this species, one knows that the water in which this plant appears is spring-fed. Such is the case also for water milfoil (*Myriophyllum*

heterophyllum), ivy-leaved duckweed (*Lemna trisulca*), water speedwell (*Veronica connata*), shining pondweed (*Potamogeton lucens*), and the others which have been listed as limited to the Ozarks.

It may be hypothesized that the species of the springs which are confined to the Ozarks illustrate by this limited distribution their relict nature or their persistence in unglaciated regions. In other words, some may argue that northern and central Missouri, having been glaciated, lost these species through destruction and elimination of their habitats, and that these species found an area in which they could survive, south of the Missouri River. Against this hypothesis, however, it should be argued that all these species which do *not* occur in the glaciated area of northern and central Missouri, *do* occur in the glaciated areas of states to the north and northeast of Missouri in habitats many of which have nothing to do with spring water, and just as surely as they can occur in the glaciated regions of these other states in non-spring habitats, so too could they occur in the glaciated sections of northern and central Missouri in non-spring habitats. The main factor for the absence of these species in northern and central glaciated Missouri appears to be lack of a suitable habitat, i.e., lack of cool spring water. The large springs in Missouri are all confined to the Ozark region, and this is related to topography and past geological history of the state. If large, cool springs were found in northern and central Missouri, then no doubt these same species would appear in the glaciated portions of Missouri as well. In the states north and northeast of Missouri these same species occur in the cool waters of lakes, streams, and sloughs, as well as in springs.

In the many cases of other species in the Missouri flora, discussing now those not found in spring water, there are many which, unlike those confined to the springs in the Ozarks, seem restricted to the Ozarks because they have persisted in an unglaciated region; in the Ozark region they have remained in such suitable restricted habitats as were left to them after similar ones had been destroyed in the now glaciated areas of northern and central Missouri. No doubt, suitable types of habitats related to a certain topography, or rock substratum or geological structure, are exceedingly important, and are involved in many cases where the species is now restricted to an unglaciated region because the habitats it seeks have been destroyed or eliminated or have become inaccessible in glaciated areas where presumably they may have previously have occurred before glaciation took place.

Even though the Kansan and Iowan glaciations in Missouri were old ones, preceding the recent Illinoian and Wisconsin ice sheets

(which did not come into Missouri), and would have allowed sufficient time for Ozark spring-inhabiting and other types of Ozark species to spread into and invade habitats to the northward in Missouri, the fact remains that throughout all the time since the last glaciation in Missouri, few of these Ozark-confined species have ever spread into this glaciated area. In the case of many of these species the habitat can no longer be duplicated or it may have been destroyed and never regained. In the case of the spring-inhabiting species there seem to be no cool spring waters available in northern and central Missouri, and this appears to be the chief if not the only reason for their absence from that area.

THE INFLUENCE OF SPRINGS ON THE MISSOURI FLORA

As has been brought out in the preceding section of this report, the water of the springs averages much cooler (52°–58° F.) than that of rivers, lakes, or other bodies of water. This cooler water is the habitat of a limited number of species which are not found, or very rarely found, outside of spring water. Mention of species confined to springs or spring water in Missouri includes *Sparganium americanum*, *Potamogeton amplifolius*, *P. lucens*, *P. crispus* (introduced from Europe), *P. panormitanus* var. *major* and var. *minor*, *Anacharis occidentalis*, *Lemna trisulca*, *Rorippa Nasturtium-aquaticum*, *Ranunculus longirostris*, *Myriophyllum heterophyllum*, *Veronica connata*, and *Cardamine bulbosa* f. *fontinalis*. Their affinity for spring water is best shown by the fact that these same species suddenly disappear immediately or shortly after the influence of the cooler spring water has been lost in the river water into which the spring has emptied. These species are, for the most part, an index or guide to the occurrence of spring water or spring-fed water. Even though the waters of most Ozark streams are spring-fed, the amount of spring water in them is not sufficient to keep their temperature down to as low an average as that found in spring water. Consequently, waters of streams average higher temperatures than those of springs and harbor species most of which are never found in spring water. Examples of species found in running water of spring-fed Ozark streams and not found in cooler springs and spring branches include eel grass (*Vallisneria americana*), fennel-leaved pondweed (*Potamogeton pectinatus*), long-leaved pondweed (*Potamogeton americanus*), yellow water crowfoot (*Ranunculus flabellaris*), and large bladderwort (*Utricularia vulgaris* var. *americana*).

A number of species found in the springs are of very limited distribution in Missouri. The isolation and rarity of ivy-leaved duckweed is a good example. It is found in a few widely separated places: in Greer Spring, Oregon County; Blue Spring, Shannon County, in southeastern Missouri; Tucker Bay Spring, Ripley County; and in a spring-fed pond in Jackson County, west-central Missouri. Shining pondweed is confined to approximately fifteen springs located in the eastern and central portions of the Ozarks. Water speedwell is found in a small number of counties in the Missouri Ozarks and reaches in this region one of its southern limits of range in the United States.

The waters from springs naturally test higher in alkalinity, since nearly all the Ozark springs flow underground through water-soluble rocks which dissolve and carry with them calcium carbonate, and the outlets of nearly all the springs are from limestone rock horizons. This alkalinity may play some rôle in the delimitation of certain species to spring waters, but it would not seem to carry much weight, inasmuch as the same species are found in other portions of their range in acid or neutral waters.

A number of spring-inhabiting species also adapt themselves to warmer waters of ponds, sloughs, and slow streams. For example, water purslane inhabits the shores of slow streams, ponds, and other bodies of water. Needle spike rush and water starwort are often found around muddy margins in quiet water of upland sink-hole ponds. Water-weed, hornwort, water milfoil, white water crowfoot, and bur-reed frequently inhabit the quiet waters of spring-fed sloughs of deep standing water. Horned pondweed is often found in warm waters of salt- or sulphur-fed springs.

KEY TO SPECIES FOUND IN OR ALONG THE WATER OF THE SPRINGS AND SPRING BRANCHES

Plants with what appear to be slender, green stems and whorls of small, linear or setaceous, leaf-like parts, but which actually are only elongate cells, belong to the non-vascular, higher algae Characeae, chiefly of the genera *Nitella* and *Chara*, and are not included in this key.

1. Minute, floating plants, of a circular or oblong shape, each plant less than 8 mm. long.....2.
1. Plants not as above.....4.
2. Plants rootless.....*Wolffia punctata*.
2. Plants with roots.....3.
3. Plants with 1 root.....*Lemna*.

3. Plants with 2–16 roots.....*Spirodela*.
4. Plants in chain-like groups, each plant very small and 10 mm. long or less.....*Lemna trisulca*.
4. Plants not as above.....5.
5. Leaves provided with tiny bladders or half-moon-shaped structures; flowers yellow.....*Utricularia gibba*.
5. Leaves not as above.....6.
6. Leaves arising only at the base of the plant (basal).....7.
6. Leaves alternate, opposite, or whorled on the stem.....13.
7. Leaves at their base with a broad, triangular or arrow-shaped lobe on each side.....8.
7. Leaves not as above.....9.
8. Most of the stems and leaves growing out of water; lobes of the leaves acute or acuminate.....*Sagittaria latifolia*.
8. Most of the stems and leaves growing in the water; lobes of the leaves rounded or obtuse.....*Nuphar ozarkanum*.
9. Stems and leaves filiform, delicate, less than 0.5 mm. broad.
Eleocharis acicularis and var. *gracilescens*.
9. Stems and leaves broader, or at least without the above combination of characters.....10.
10. Stems and leaves wiry, stiff, narrowly linear or setaceous, or at most 3 mm. broad in middle and upper portions. 11.
10. Stems and leaves much broader and not as above... 12.
11. Stems creeping, usually leafless; stems mostly supporting a solitary flower spikelet; sheaths at base of stems truncate at the apex, and encircling the stem.
Eleocharis calva.
11. Stems tufted, with leaves usually present; stems supporting several to many clusters of flowers; sheaths at base of stems not truncate, open along one side.
Juncus.
12. Leaves light or grass-green; plants 3–10.5 dm. tall; flowers in white or green, rounded masses.
Sparganium americanum.
12. Leaves bluish or silvery green; plants 9–15 dm. tall; flowers in brown, club-shaped masses. *Typha latifolia*.
13. Leaves alternate.....14.
13. Leaves opposite or whorled.....27.
14. Leaves deeply lobed, deeply dissected, or divided.....15.
14. Leaves simple, not deeply lobed or divided... 16.
15. Leaves finely dissected into filiform divisions.
Ranunculus longirostris.
15. Leaves divided into 3–11 round, oblong, or ovateleaflets...*Rorippa Nasturtium-aquaticum*.
16. Leaves linear and grass-like (includes *Poa annua* var. *reptans*, *Glyceria striata*, and *Agrostis stolonifera*).....17.
16. Leaves not linear or grass-like.....21.
17. Leaves blue-green, most of them occurring on the lower half or third of the stem.
Poa annua var. *reptans*.
17. Leaves yellow- or grass-green, more or less equally distributed along the stem... 18.

18. Leaves mostly 2-6 mm. broad, without any conspicuous midrib; flowers yellow.
Heteranthera dubia.
18. Leaves 0.4-2 mm. broad, with a conspicuous midrib or, if the midrib is inconspicuous, then the leaves are 1 mm. wide or less; flowers greenish. 19.
19. Leaves 0.4-1 mm. broad, the midrib mostly not conspicuous; flowers occurring along the sides of the stem.
Zannichellia palustris var. *major*.
19. Leaves 1-2 mm. broad, the midrib conspicuous; flowers occurring at the ends of the stem. 20.
20. Peduncles 0.4-1 cm. long, usually thickened in the upper part; stems either unbranched or with short branches or not much branched.
Potamogeton foliosus and varieties.
20. Peduncles usually 1.5-8 cm. long, thread-like, scarcely thickened in the upper part; stems usually long and much branched.
Potamogeton panormitanus and varieties.
21. No sheathing stipules present at the base of the leaves. 22.
21. Sheathing stipules present at the base of the leaves. 23.
22. Leaves light or grass-green; basal and lowest leaves rounded or obtuse at the apex; main cauline leaves not deeply cordate at the base; small tubers occurring on rootstock; no creeping rootstocks present.
Cardamine bulbosa f. *fontinalis*.
22. Leaves dark green; basal and lowest leaves acute or acuminate at the apex; cauline leaves deeply cordate at the base; no small tubers present on the rootstock; long, creeping rootstocks present. . . *Saururus cernuus*.
23. Leaves with only 1 nerve running lengthwise; sheathing stipules with a fringe of bristles or long hairs around the border. 24.
23. Leaves with at least 3 nerves running lengthwise; sheathing stipules not fringed nor with long hairs. 25.
24. Perennial plants, often completely submerged in spring water.
Polygonum hydropiperoides.
24. Annual plants, rooting on land, never submerged in spring water.
Polygonum punctatum.
25. Leaves with finely toothed margins; only 3 main longitudinal nerves present; none of the leaves petioled. . *Potamogeton crispus*.
25. Leaves with entire margins; 11-50 longitudinal nerves present; at least the lower leaves petioled. 26.
26. Leaves with 11-13 longitudinal nerves, submerged leaves not strongly wavy or recurved. *Potamogeton lucens*.
26. Leaves, at least the floating ones, with 17-50 longitudinal nerves, submerged leaves strongly wavy or recurved.
Potamogeton amplifolius.
27. Leaves usually in whorls of 3-6. 28.
27. Leaves in pairs always opposite on the stem. 32.
28. Leaves in whorls of usually 3 narrow, undivided and undissected leaves. *Anacharis occidentalis*.
28. Leaves in whorls of 4, 5, or 6, filiform or capillary, divided and dissected leaves. 29.
29. Leaves forked and branched; leaf segments with teeth or irregularities on margins. . *Ceratophyllum demersum*.
29. Leaves pinnately parted; leaf segments without teeth or other irregularities on the margins. 30.

30. Leaves bluish or grayish green; all the leaves similar in appearance *Myriophyllum proserpinacoides*.
30. Leaves dark or grass-green, brown, or brownish green; upper emersed leaves different in appearance from the lower immersed ones 31.
31. Rare; some of the leaves on the plant not whorled; stems mostly creeping and prostrate, slender, usually less than 1 dm. tall; emersed and floral leaves linear, deeply toothed or cut.
Myriophyllum scabratum.
31. Common; all the leaves whorled; stems usually upright and elongate, stout, usually more than 3 dm. tall; emersed and floral leaves ovate to oblanceolate, entire or slightly toothed.
Myriophyllum heterophyllum.
32. Leaves, when crushed, with a mint odor; leaves serrate *Mentha piperita*.
32. Leaves without this combination of characters. 33.
33. Most or all of plant growing on land 34.
33. Most or all of plant submerged in water . . 36.
34. At least some of the leaves faintly toothed or with irregular margins; leaves mostly 8–30 mm. broad.
Veronica connata and var. *glaberrima*.
34. All the leaves with entire margins; leaves 1–8 mm. broad 35.
35. Leaves noticeably tapering at the base, subpetiolate, 3–8 mm. broad, broadest near the middle.
Rotala ramosior var. *interior*.
35. Leaves only slightly tapering at the base or sessile, not subpetiolate, 1–3 mm. broad, mostly of about the same width from base to apex *Peplis diandra*.
36. At least some of the leaves faintly toothed or with irregular margins; leaves mostly 8–30 mm. broad.
Veronica connata and var. *glaberrima*.
36. Without the above combination of characters 37.
37. Submerged leaves mostly spreading upward or ascending; leaves with very minute teeth on each margin (use magnifying lens).
Najas guadalupensis.
37. Submerged leaves mostly wide-spreading; leaves with entire margins (use magnifying lens) 38.
38. Leaves light or pale green; leaves with usually 2 different shapes present on the same plant, the linear leaves 1–1.5 mm. broad.
Callitriche heterophylla.
38. Leaves dark or dull green, all similar in shape on same plant, 1.5–2.5 mm. broad . . . *Peplis diandra*.

DESCRIPTION OF SPRINGS, AND THE OCCURRENCE AND ENUMERATION OF THEIR FLORA

In the following pages are described the occurrences and habitats of the flora of each major spring in Missouri:

ALTHEA SPRING (Plate I)

Located in sec. 25, T. 23 N., R. 12 W., at Althea, Ozark County. The water rises in a circular basin about three and one-half feet deep and 20 to 25 feet in diameter, and comes out of limestone boulders bordered above by ledges of Roubidoux sandstone. In the water occur mostly rocks that are covered with mosses and a liverwort (*Porella pinnata*). A slight amount of milfoil and water starwort grows with the mosses.

The water plunges rapidly from the circular basin into a spring branch about two feet in depth. This branch curves about, and along the sides contains many algae associated with water cress. Going downstream the branch is about 30 feet wide and the main current flows over quantities of milfoil, which is the dominant plant in the branch. Along the sides of the branch are strands of water starwort, bur-reed, and horned pondweed.

Just before coming to its first rock dam, the branch for 25 to 30 feet is loaded with sandy mud and has a swift current. Here occur flowing mats of milfoil, light green plants of horned pondweed, bur-reed, needle spike rush, light green in color, and large, robust strands of water-weed. The milfoil is the commonest species here.

Between here and the second dam of the branch, the water flows rapidly, the dominant plant being horned pondweed. Scattered with it are milfoil and water starwort. Then water starwort and horned pondweed predominate in the swift flow of the water to the third dam.

From the third dam to the North Fork of White River the water tumbles over rocks covered with moss and algae, with water cress scattered here and there. Just below the third dam and growing along the side and away from the current is an occasional plant of hornwort. The substratum of this portion of the branch is loose and has clear-colored sand and gravel.

Near its confluence with the North Fork of White River the spring branch contains water milfoil, water cress, and horned pondweed as its chief components. Occasional clumps of dark, bright, grass-green pondweed (*Potamogeton foliosus* var. *macellus*) also occur.

The total distance of flow of the branch from its outlet to the North Fork of White River is 600 feet.

LIST OF SPECIES

Liverwort (<i>Porella pinnata</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Water milfoil (<i>Myriophyllum heterophyllum</i>)	Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water-weed (<i>Anacharis occidentalis</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Bur-reed (<i>Sparganium americanum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)

ALLEY SPRING

Located in sec. 25, T. 29 N., R. 5 W., at Alley Spring State Park, five miles west of Eminence, Shannon County. The water "issues from the base of a rocky cliff, flows over a dam which develops power for a grist mill, and empties into Jacks Fork at a distance of a half-mile." The water is of a slightly lighter blue color than that of Round Spring. The basin or lake portion of the spring is 150 to 200 feet wide. The water here is deep and the banks are steeply sloping. Along the margin of the basin occur water milfoil and water cress. Water starwort occurs in places within the basin.

From the basin the water of the spring pours down over rocks at two places, and these branches join about 50 feet farther down. The water here is rapid and shallow, flowing over a gravel bottom. Along the left branch as one goes downstream, where the water rushes out, occur light grass-green mats of spring cress submerged in the water or sending up flower stalks above the surface, and surrounded by rocks covered with mosses and green algae. The right branch has quantities of mosses and algae. Farther down its course there is much water cress.

The main spring branch continues downstream and makes a slight turn. At this point a little overflow from the branch is filled with still water and on its shallow side has bur-reed and water cress.

Thus far in the main branch there have appeared only water cress, peppermint, and an occasional clump of water speedwell. Farther down, however, on the gravel substratum occur a little water starwort and spring cress, but water cress continues to be the chief species. As a whole, the vegetation is really scattered, with green and blue-green algae and mosses occurring plentifully.

Farther down, a portion of the branch winds about and, before meeting the main branch again, forms a small backwater or slough

with mud bottom and quiet water away from the main current. Here occur bronze-colored pondweed (*Potamogeton foliosus* var. *genuinus*), bur-reed, and water speedwell. The last, a dull olive-green in color, occurs in close mats with small leaves, along the side of the water. From here on down and in the lower half of the branch, these latter two species become commoner.

In the lower half of the spring branch the water speedwell is common. With it is a clump of water-weed (*Anacharis occidentalis*), a slight amount of milfoil, water starwort, and a large quantity of water cress. About halfway down this branch submerged plants of annual bluegrass occur.

The branch has now become large and is about 35 feet broad. It makes several bends before emptying into Jacks Fork of Current River. Just below the limits of Alley Spring State Park at a flood-gate on the right bank of the branch in a muddy place, occur some dark, grass-green plants of a species of *Chara*. At another place above this gate, away from the main current, is found some dark, grass-green pondweed (*Potamogeton foliosus* var. *genuinus*). In its last one-fourth of flow before reaching the river, a large gravel bar is seen along one side of the branch and a limestone bluff covered with red cedar (*Juniperus virginiana*) on the other. In this last portion and at the confluence with the river, water speedwell is the chief aquatic plant, and both the species and variety (*Veronica connata* and var. *glaberrima*) occur here. The plants of *Veronica connata* found in the upper half of the branch near the main outlet, where the water is deeper, are larger-leaved than those in the lower half of the branch.

LIST OF SPECIES

Water milfoil (<i>Myriophyllum heterophyllum</i>)	Water speedwell (<i>Veronica connata</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Water-weed (<i>Anacharis occidentalis</i>)
Spring cress (<i>Cardamine bulbosa</i> f. <i>fontinalis</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>repens</i>)
Bur-reed (<i>Sparganium americanum</i>)	Water speedwell (<i>Veronica connata</i> and var. <i>glaberrima</i>)
Peppermint (<i>Mentha peperita</i>)	

AMSDEN MILL SPRING

Also called Purtle's Spring, Amazon Spring, and Amsolen Spring; located in sec. 19, T. 31 N., R. 1 E., six miles south of Centerville, Reynolds County. The water used to bubble up from a gravel bed, but has been dammed to form a lake. The water flows from the lake as falls over a pipe and empties into the creek. The water in

the lake basin is mostly overgrown with water-weed, which, according to the owner of the property in 1936, was introduced and planted in the spring in 1934. At one end of the basin are quantities of cat-tail, along one side is creeping spike rush, and along the margins of the lake is knotty-leaved rush. Other water plants occurring in the lake basin are dull green plants of pondweed, scattered plants of water purslane, bur-reed, and grass-leaved sagittaria.

LIST OF SPECIES

Bur-reed (<i>Sparganium americanum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)
Water-weed (<i>Anacharis occidentalis</i>)	
Cat-tail (<i>Typha latifolia</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Creeping spike rush (<i>Eleocharis calva</i>)	
Knotty-leaved rush (<i>Juncus acuminatus</i>)	Grass-leaved sagittaria (<i>Sagittaria graminea</i>)

ASPLEY SPRING

Located in sec. 28, T. 27 N., R. 5 E., two miles south of Williamsville, Wayne County. The spring rises in a small basin at the base of a rocky, wooded bluff, and the branch is dammed to form a lake. It is filled with many plants, including a species of *Chara*, bur-reed, water purslane with copper-colored leaves, pondweed, and water-weed.

The branch then flows from the lake and empties into Black River, a short distance away.

LIST OF SPECIES

Bur-reed (<i>Sparganium americanum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)
Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)	Water-weed (<i>Anacharis occidentalis</i>)
	<i>Chara</i> sp.

BARTLETT MILL SPRING

Located in sec. 16, T. 36 N., R. 12 W., at Pippin Lodge, five miles northwest of Waynesville, Pulaski County. It rises in a long, elliptical-oblong basin at the base of a small, wooded, non-rocky hill. From the very beginning to a point where the water flows over a dam, it is very deep. "The water flows 600 feet to a dam 10 feet high where power is developed to operate a mill and to furnish electric lights for the lodge, and empties into Gasconade River." In the deep basin the aquatic plants are milfoil, water-weed, water starwort, water cress, and, along the margin, a liverwort (*Porella*). Of these the milfoil is by far the commonest, and with its long, sterile, brown strands, forms most of the vegetation. The water cress grows in submerged, green masses.

Only a short spring branch flows from the overflow of the dam to the Gasconade River. Over some artificial rocks composed of

cement and at the base of the overflow in the current of the water grows milfoil, and along the margin some plants of water star-grass, while rooting in the sand are plants of water starwort and horned pondweed.

On the muddy substratum along the margin of the Gasconade River at its junction with the spring branch are plants of hornwort.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Water star-grass (<i>Heteranthera dubia</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Liverwort (<i>Porella</i>)

BEAVER SPRING

Located in sec. 34, T. 37 N., R. 5 W., six miles west of Steelville, Crawford County. It rises in a small opening at the head of a broad ravine at the base of a small limestone bluff 20-30 feet high, and then flows through a rock-lined chute about 25 feet long. This is filled with many plants of shining pondweed and with bronze or dull green pondweed.

The water continues from the chute into two lake basins. The first lake is filled with shining pondweed, while associated with this are plants of horned pondweed. In the second lake basin shining pondweed also is abundant and the dominant species.

The spring branch then flows from the second lake into the valley through which it winds. The branch, shallow and with a gravel bottom, is soon joined by another spring branch which issues from a field. This latter spring branch contains water cress, bur-reed, and water purslane.

Both branches merge and continue down the valley. From this point on, the water is devoid of any vegetation except water cress, and moss on the rocks.

LIST OF SPECIES

Shining pondweed (<i>Potamogeton lucens</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Bur-reed (<i>Sparganium americanum</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)

BENNETT SPRING (Plate I)

Also called Niangua Spring and Brice Spring. It is located in sec. 1, T. 34 N., R. 18 W., at Brice, in Bennett Spring State Park, Laclede County. The water issues from a circular basin 50 feet in

diameter in a gravel bed and flows one and one-half miles into Niangua River.

Around the edges of the circular spring basin are algae, mosses, and water cress, while at the beginning of the spring branch are occasional plants of bur-reed. Following down the branch, purplish submerged plants of mild water pepper, milfoil, and bur-reed are found. Large mats of water cress occur all the way down the spring branch.

Proceeding downstream, a series of sloughs or quiet extensions of the spring branch occur. In the first slough are milfoil, white water crowfoot, green mild water pepper, and bur-reed.

Downstream from the first slough are noticed large mats of water-weed along the side of the branch above a bridge. At one place is a small patch of red and green plants of water purslane, and this is the only place along the branch where the species was observed. A dam in the spring branch is used to develop power for a grist mill at Brice, and a series of trout hatcheries is located around the mill. Just above the falls, by the dam, in deep and more quiet water, are large beds of milfoil. Thus far along the spring branch milfoil and water-weed have been the most common plants, and water starwort and water cress also have been common. Dark bronze-green plants of pondweed (*Potamogeton foliosus* var. *macellus*) occur here, and this is as far down the branch as this species grows. Between here and the main spring are many more plants of it. Between the bridge by the hatchery and the mill are beds of milfoil, with occasional plants of bur-reed, water cress, and aquatic mosses.

By the mill race in the adjacent slow water is a large bed of white water crowfoot, associated with smaller amounts of water speedwell and water starwort. Below the mill race the water becomes deeper and more quiet, and the result is a greater variety of aquatic plants. Here are large mats of milfoil, some water speedwell, water cress, water-weed, reddish-tinged, submerged plants of mild water pepper, and small amounts of water starwort. This combination of aquatic plants continues for a greater part of the distance down the stream. The branch has dense clumps of water cress and needle spike rush along its banks.

Proceeding downstream, milfoil and mild water pepper are the commonest plants, with milfoil the more abundant. Farther down the branch the milfoil for the first time does not occur in mats. Dark grass-green plants of horned pondweed grow with water speedwell, algae, and mosses.

The spring branch then flows rapidly into the Niangua River. At and near the confluence water plants are sparse, only mosses and milfoil being found here. Water cress is the commonest plant between the circular spring basin and the dam, while milfoil is the commonest between the dam and Niangua River.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water starwort (<i>Callitriche heterophylla</i>)
Bur-reed (<i>Sparganium americanum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)
Mild water pepper (<i>Polygonum hydro-piperoides</i>)	Water speedwell (<i>Veronica connata</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)
White water crowfoot (<i>Ranunculus longirostris</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Water-weed (<i>Anacharis occidentalis</i>)	
Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)	

BIG SPRING (Plates II and III)

Located in sec. 6, T. 26 N., R. 1 E., four miles southeast of Van Buren, in Big Spring State Park, Carter County. The water gushes from the base of a rocky cliff and flows 800 feet before emptying into Current River. Where the main jet of water rushes out, only algae and mosses cover the rocks. No species of higher plants is found until the water has become more quiet.

The aquatic vegetation is prolific, and very rich and diversified throughout the spring branch. Proceeding down the branch along the left margin in gravelly mud are submerged, red and olive-green mats of mild water pepper associated with aquatic mosses. On the same left side, near the *Polygonum*, are long strands of milfoil and olive-grass-green strands up to four feet long of shining pondweed. Near the shore are olive-green strands of water star-grass, and water starwort, the latter in the shallowest, broadest portions of the cove. In the muddy portions near shore grows hornwort. The most common plant in this part of the branch is milfoil.

Proceeding downstream from this point, long strands of milfoil grow along both sides of the spring branch, but in the middle of the branch and between the strands of milfoil the water is clear and light blue and no plants are present. With the milfoil are dark grass-green strands three to four feet long of pondweed (*Potamogeton foliosus* var. *genuinus*) and dark copperish red and green clumps of water purslane. On the muddy substratum are shining pondweed and water star-grass. The last, with its broader and more curved leaves of a duller brown color, contrasts strongly with the greener leaves of the pondweed (*Potamogeton foliosus* var. *genuinus*).

Following down the branch, submerged clumps of flowering annual bluegrass occur with an occasional clump of water speedwell. About 200 yards downstream, on the muddy substratum, occurs horned pondweed, covered with a brown-colored alga. At this place water cress makes its appearance, and here also are some purplish red, submerged plants of mild water pepper.

Downstream there is a slough of quiet water filled with water-weed, milfoil, shining pondweed, water starwort, mild water pepper, and water cress. Covering the entire muddy bottom of this slough is water star-grass. On the left side of the slough, and between it and the confluence of the spring branch is a sandbar, on the freshly deposited part of which are young plants of horned pondweed and pondweed (*Potamogeton foliosus* var. *genuinus*). Milfoil is common here as in all other places along the branch.

Along the right side of the branch, near its confluence with Current River, are mats of milfoil and water-weed, together with water cress and pondweed (*Potamogeton foliosus* var. *genuinus*).

In the final portion of the spring branch, along the right side, the water is deeper and away from the current is seen a diversity of aquatic plants, for here the flora is more luxuriant in number of species than on the left side. Here are water star-grass, water cress, shining pondweed, water starwort, and mild water pepper.

The shining pondweed in the quiet water has erect, curved, and ascending leaves, but in running water the leaves have a darker, more grass-green color and the margins are less curled or ruffled.

Following the entire course of the spring branch, switch cane (*Arundinaria gigantea*) and mistletoe (*Phoradendron flavescens*) are very common, the latter occurring on sycamore (*Platanus occidentalis*) and American elm (*Ulmus americana*).

LIST OF SPECIES

Mild water pepper (<i>Polygonum hydro-piperoides</i>)	Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>repens</i>)
Shining pondweed (<i>Potamogeton lucens</i>)	Water speedwell (<i>Veronica connata</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Water star-grass (<i>Heteranthera dubia</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Water-weed (<i>Anacharis occidentalis</i>)
Hornwort (<i>Ceratophyllum demersum</i>)	

BIG SPRING

Located in sec. 19, T. 25 N., R. 31 W., at Neosho, Newton County. It issues from two places at the base of a limestone bluff in front of

the Big Spring Inn. At the base of the bluff it is walled in a narrow basin; then it flows over a gravel substratum. The water here is about one and one-half feet deep. With a gush, the water rushes under a bridge, then flows rapidly down over moss-covered boulders and rocks to the Big Spring Inn. The only higher plant at present known in the spring is water cress, and this occurs only in the shallower part of the branch. Formerly, around 1900, water-weed grew in the spring, but it has been exterminated. The collection of this *Anacharis* made by Mr. Henry Eggert resembled *A. canadensis*, because of exceptionally broad, ovate-lanceolate leaves, but the specimens evidently represent only an unusually vigorous vegetative state of *A. occidentalis*. Some plants of forget-me-not have been planted around the spring branch and grow partly in and along the water.

LIST OF SPECIES

Water cress (*Rorippa Nasturtium-aquaticum*)

Water-weed (*Anacharis occidentalis*)
Forget-me-not (*Myosotis scorpioides*)

BIG SPRING (Plate III)

Located in sec. 2, T. 28 N., R. 27 W., four miles west of Mount Vernon, Lawrence County. It issues from the base of an exposed, arching, limestone bluff 120 feet high, known as Baptist Hill. The spring branch is rather wide and shallow where it issues from several places at the base of the bluff. Here it flows over rocks covered with moss and algae. The branch at first is about 30 feet wide. Farther downstream it is deeper and contains quantities of milfoil and water cress. The spring branch has a total flow of about 200 feet before discharging into Spring River. The milfoil continues in Spring River for some distance down the stream.

LIST OF SPECIES

Milfoil (*Myriophyllum heterophyllum*)

Water cress (*Rorippa Nasturtium-aquaticum*)

BLISS SPRING

Located in sec. 7, T. 25 N., R. 2 W., in a small valley near Eleven Points River, two and one-half miles southwest of Wilderness, Oregon County. The spring arises in a small opening at the base of a slope in the valley and flows as a branch one-fourth of a mile before emptying into Eleven Points River. The only higher aquatic plants in the spring and branch are water starwort and water cress. Knotty-leaved rush occurs along the branch. The water is shallow and flows over a gravel substratum.

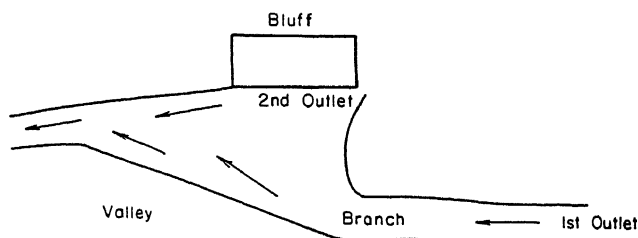
LIST OF SPECIES

Water starwort (*Callitriche heterophylla*)
 Water cress (*Rorippa Nasturtium-aquaticum*)

Knotty-leaved rush (*Juncus acuminatus*)

BLUE SPRING (Plate V)

Located in sec. 16, T. 22 N., R. 2 W., at "The Narrows," near the confluence of Fredericks Fork with Eleven Points River, about one mile northwest of Calm, Oregon County. The spring issues from two outlets. One outlet emerges at the base of a small bluff, and runs as a small spring branch over a sandy bottom bordered along the margins by mud. Here are water starwort, horned pondweed, a fresh-water red alga (*Batrachyspermum*), and milfoil. The last species is the commonest. This branch from the one outlet runs into the large spring or second outlet which issues from the base of a limestone cliff, "The Narrows," about 150 feet high, which separates Fredericks Fork from Eleven Points River. This larger spring from the second outlet is deep, has a blue color, and broadens into a triangular area.



The two branches converge and flow as one over a deep, sandy, mud bottom with muddy banks. Here are found milfoil and light green plants of horned pondweed. On these muddy bottoms the branch is practically devoid of vegetation. Along the muddy margins here are bronze and purplish plants of hornwort, which has a darker cast than has milfoil, when the two occur together.

Farther downstream, the following plants grow along the muddy margins: hornwort, horned pondweed, and pondweed (*Potamogeton foliosus* var. *genuinus*). In the part of the water colored a steel gray-blue, the milfoil is commonest.

Along the bend of the branch on the other side and at the base of a bluff are large beds of milfoil mixed with copper-colored plants of mild water pepper. Water cress also occurs here.

Near the confluence of the spring branch with Eleven Points River, milfoil and mild water pepper are dominant plants. All the

way down its course, the color of the water in the spring branch has been a clear steel gray-blue, varying from blue to gray-blue and back again to a blue. The total flow of the branch is 200 feet.

LIST OF SPECIES

Water starwort (<i>Callitriche heterophylla</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)
Mild water pepper (<i>Polygonum hydro-piperoides</i>)	Fresh-water red alga (<i>Batrachyspermum</i>)

BLUE SPRING (Plate IV)

Located in sec. 30, T. 36 N., R. 17 W., six miles west of Eldridge, Laclede County. It issues from the base of a limestone bluff about 30 feet high and wooded above. It begins in a circular basin of deep and dark blue water. Milfoil borders the basin, growing on mud.

The branch then flows 200 feet and empties into Niangua River. The water is rather deep (2-3 feet) and about 30-50 feet wide. In it are many plants of hornwort and submerged mild water pepper. The latter species is exceedingly colorful because its broad leaves are bronze-purple on the lower surface and olive-green on the upper; it is the commonest species along the margin of the branch. In the center of the stream, where the current is swift and the substratum is more sandy, are bluish green plants of horned pondweed, this species being the common and dominant one in this part of the spring branch. Some water cress grows scattered among plants of mild water pepper, while light green strands of water starwort appear among clumps of hornwort.

The most interesting feature of the spring is the fact that milfoil is not the dominant aquatic plant, as is the case with most springs in the Ozarks. It appears around the main basin and there is a slight amount of it along the margin of the spring branch near its confluence with the Niangua River. The commonest aquatic plants in the spring are hornwort and mild water pepper.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Hornwort (<i>Ceratophyllum demersum</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Mild water pepper (<i>Polygonum hydro-piperoides</i>)	
Water starwort (<i>Callitriche heterophylla</i>)	

BLUE SPRING

Located in SW. $\frac{1}{4}$ NW. $\frac{1}{4}$ sec. 14, T. 24 N., R. 11 W., at McCabe, Ozark County. The spring bubbles up in a basin 20 feet deep at the

base of a small limestone cliff 30 feet high, along the side of the North Fork of White River. There is practically no spring branch, since the water flows only about 25 feet before emptying into the North Fork of White River. In the spring and spring branch only water starwort occurs. Along the North Fork of White River, downstream from the confluence with the spring branch, grow milfoil, water star-grass, water-weed, and pondweed (*Potamogeton foliosus* var. *genuinus*).

LIST OF SPECIES

Water starwort (<i>Callitriche heterophylla</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	
Water star-grass (<i>Heteranthera dubia</i>)	Water-weed (<i>Anacharis occidentalis</i>)

BLUE SPRING

Located in sec. 2, T. 39 N., R. 3 W., two miles southeast of Bourbon, Crawford County. The spring rises in a wooded valley in a park which has a fish hatchery. The water rises at one place in a concrete-lined pool, the deep blue water arising from a hole in the limestone substratum. Two lakes, Blue Spring Lake and Osage Lake, are formed by damming the spring. The water of the spring and lakes is of a deep blue color. In Blue Spring Lake roots of white willow covered with algae occur all around the margin of its concrete-lined pool. In this place curly-leaved muck-weed is dominant and abundant. It is of a dark, brown-green color and the stems grow upright with the leaves growing out distichously. Scattered with the algae are broad-leaved pondweed, pondweed (*Potamogeton foliosus* var. *genuinus*), a small amount of water starwort, and some water-weed. The water flows into a lake basin filled with rainbow trout.

A part of this main spring is then diverted into another place underground, coming out through a pipe which gushes forth a large amount of water. Here the bottom is gravelly mud and is covered mostly with curly-leaved muck-weed and water-weed.

Another part of the spring emerges at the base of a small ledge farther down the valley and has a muddy bottom covered with water-weed growing in dense, light-green beds. Some curly-leaved muck-weed and pondweed (*Potamogeton foliosus* var. *genuinus*) occurs here. Lying on the mud in quiet water are many clumps of green algae. Rice cut grass (*Leersia oryzoides*) grows all along the margin. This part of the spring is separated by an earth fill from the main part, which flows quietly over the muddy bottom. It is a large, shallow pool about 75 feet long and 45 feet broad, known as Osage Lake.

Lining the pool and growing in mud are water cress, water starwort, white water crowfoot, curly-leaved muck-weed, and water-weed. Of these species the curly-leaved muck-weed is dominant, with scattered plants of water cress and water-weed next most common. Clumps of green algae grow plentifully in this basin, and along the rock ledges on one side are quantities of myrtle (*Vinca minor*).

This portion of the spring flows underneath the hill and has an outlet on the other side, forming another flow which runs as a small branch without higher plant life. It eventually enters a pool filled with algae and having a gravelly mud bottom.

The main spring branch from Osage Lake described above flows as a narrow branch over a concrete bottom lined with blue-green algae, and eventually enters the gravel-laden creek. The diverted basin portion of Blue Spring Lake runs as a long branch with an abundance of trout, but it does not contain higher plant life. This main branch continues, with water one and one-half feet deep. The stream has a concrete-lined bottom and sides.

Across the road from the spring area described above, the water is diverted into a couple of lakes bordered by sandbar willow (*Salix interior*). The first lake (the one nearest the spring outlet) is filled with quantities of water feather, water-weed, and curly-leaved muck-weed. Some Ozark spatterdock also grows here.

The other lake is about 300 feet long and 100 feet broad, and is larger than the first. The surface of the water is covered with sweet-scented water lily, and there is an abundance of hornwort. In one place along the margin of the lake in quiet water is lesser duckweed, while along the margins in deep, quiet water commonly occur naiad and water feather. False nettle (*Boehmeria cylindrica*), field mint (*Mentha arvensis* var. *glabrata*), mad-dog skullcap (*Scutellaria lateriflora*), boneset (*Eupatorium perfoliatum*), and ironweed (*Vernonia crinita*) occur along the banks. Some pickerel-weed grows along one edge of the muddy margins with broad-leaved arrowhead and some water purslane.

The water from the first lake falls over a concrete spillway about one-quarter mile from the source of Blue Spring. At the place where it falls grow hornwort, naiad, sweet-scented water lily, Ozark spatterdock, some water feather, and curly-leaved muck-weed. Water cress and water purslane are found on the gravelly substratum in the current along the margin of the branch.

This flows into the main spring branch, which continues over a limestone and gravel stream bed in shallow water. The most common

plants here are water cress and water feather. All along the margin of the branch grow water-weed and curly-leaved muck-weed. In a shallow and more quiet section of the branch is hornwort. In a portion of the branch with a fast current and a gravelly mud or silty sand substratum is found horned pondweed (*Zannichellia palustris* var. *major*). Along the margin is cat-tail with scattered plants of yellow flag (*Iris pseudacorus*). Curly-leaved muck-weed, so plentiful at Blue Spring, is an introduced species which is very rare in Missouri, being known otherwise in the state only from a spring in Newton County.

LIST OF SPECIES

Curly-leaved muck-weed (<i>Potamogeton crispus</i>)	White water crowfoot (<i>Ranunculus longirostris</i>)
Broad-leaved pondweed (<i>Potamogeton amplifolius</i>)	Ozark spatterdock (<i>Nuphar ozarkanum</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Sweet-scented water lily (<i>Nymphaea odorata</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Lesser duckweed (<i>Lemna minor</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Naiad (<i>Najas guadalupensis</i>)
Water feather (<i>Myriophyllum proserpinacoides</i>)	Pickrel-weed (<i>Pontederia cordata</i>)
Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)	Broad-leaved arrowhead (<i>Sagittaria latifolia</i>)
	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)

BLUE SPRING

Located in NE. $\frac{1}{4}$, sec. 21, T. 29 N., R. 2 W., 12 miles east of Eminence, and two miles east of Powder Mill Ford, Shannon County. The water, of dark turquoise-blue color, flows out of a deep hole at the base of a limestone bluff. The rim of this basin is rocky and appears as if it were a part of the bluff which surrounds it. Over the top of this rocky rim is a muddy substratum. All around its crater the spring basin is lined with bur-reed, growing as far down as 10 to 12 feet below the surface of the water. Because of the muddy substratum and quiet water, the bur-reed is common in the beginning. Nearer the shore and along the margin, also on the muddy substratum, grow water starwort, needle spike rush, water speedwell, water cress, and water-weed. Near the margin the mud is mixed with a little gravel. Various water mosses cover submerged boulders around the basin. All along the shore of this basin water cress is abundant, growing in shallow water on mud with water-weed and water speedwell. A small amount of ditch stonecrop is found in mud around the margin.

As the water leaves the beautiful blue basin and starts a spring branch, water cress is the first higher plant to be seen. It grows

submerged at the beginning of the branch. In sandy silt away from the current, along the margin of the branch, are submerged bunches of ivy-leaved duckweed and spring cress, growing with water cress. Proceeding down the branch, water starwort is encountered along the margins.

In the beginning this spring branch is 50 feet wide, one and one-half to two feet deep, and flows mostly over large pieces of rock and gravel. The rocks are covered by dark green and blackish green species of moss. About 100 feet downstream on the south or left side along the margin of the spring branch are plants of bur-reed. Across from these plants on the other side are clumps of water cress, water speedwell, and spring cress (*Cardamine bulbosa* f. *fontinalis*) growing on gravel in 6 to 12 inches of water near the margin where the current is less swift.

The branch continues, flowing over water speedwell and water cress, which grow near the margin in shallow water. Beds of mosses and floating green algae cover the surface on both sides of the stream, growing away from the direct flow of the current. In shallow, swift water on the gravel occur submerged blue-green strands of red top grass near the margin of the branch where water cress and water speedwell are growing.

Then, about 75 yards farther downstream, the spring branch passes a small, low island, 75 feet long and 50 feet broad. Its middle portion has been cut through by part of the spring branch, while two other branches of the spring pass on either side. The spring branch thus makes three forks here. The swiftest current is in the left fork, which dashes rapidly over moss-covered rocks, making white foam. The other forks are shallower. Only moss and algae grow here, with a small amount of spring cress (*Cardamine bulbosa* f. *fontinalis*) and water speedwell, both species occurring more plentifully where the water is quieter. Growing submerged and prostrate along the gravelly margin of the right side of the left branch is false dragon-head with dark green leaves.

Soon the forks join and the branch is narrow, only 20 feet broad at their junction, but it is faster and deeper here than above. It makes a sharp bend, then flows over light-colored gravel with mosses covering the rock. As the water becomes deeper in one place, it assumes a steel gray-blue color.

Then the branch reaches a more shallow stretch, where it flows over gravel and broadens to 30 feet across. Here bur-reed, of a rich green color, occurs on one side, while on the other side along the

margin growing on the gravel in shallow water are submerged, long (3–4 feet), grass-green strands of fowl meadow grass with water speedwell. The fowl meadow grass is readily distinguished by its distichous leaves of equal length appearing all along the stem, while submerged or sterile plants of red top grass, which may be confused with it, have paler, blue- or gray-green leaves which are long and unequal and appear only near the base of the plant. A small quantity of white water crowfoot occurs by the island.

In a place away from the current, where the gravel has been swept away, is a mud bar, and on it grow clumps of water starwort and water speedwell. Spring cress (*Cardamine bulbosa* f. *fontinalis*) and bur-reed occur near here in gravel in deeper water.

The spring branch, after a flow of one-quarter of a mile, makes another bend and flows swiftly, three to four feet in depth, just before it enters Current River. At the confluence it has a deep blue color. Just at the mouth on gravel and in 6 to 12 inches of water are blue-green clumps of fowl meadow grass. Its leaves are blue-gray on the upper surface and grass-green on the lower. Also at this point in shallow water on gravel is a small amount of water cress. On the other (north) side of the confluence the water is deeper.

Immediately downstream from the confluence (about five feet away) the water in Current River is warmer and of a bronze-green color. Here are plants of long-leaved pondweed with narrow and submerged leaves. This species is one which avoids the colder water of the springs, so that its appearance in the warmer water of the river proper, yet only a few feet from the mouth of the spring branch, illustrates how important the factor of water temperature is in relation to the distribution and occurrence of aquatic species.

An interesting and unusual feature of Blue Spring is the relative abundance of ivy-leaved duckweed, a species that is seldom found in Missouri.

LIST OF SPECIES

Bur-reed (<i>Sparganium americanum</i>)	Spring cress (<i>Cardamine bulbosa</i> f. <i>fontinalis</i>)
Water starwort (<i>Callitriche heterophylla</i>)	False dragon-head (<i>Physostegia virginiana</i>)
Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)	Water speedwell (<i>Veronica connata</i> var. <i>glaberrima</i>)
Water speedwell (<i>Veronica connata</i>)	White water crowfoot (<i>Ranunculus longirostris</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Ivy-leaved duckweed (<i>Lemna trisulca</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Red top grass (<i>Agrostis stolonifera</i>)
Ditch stonecrop (<i>Penthorum sedoides</i>)	Fowl meadow grass (<i>Glyceria striata</i>)
Spring cress (<i>Cardamine bulbosa</i>)	

BLUE SPRING

Located in sec. 4, T. 25 N., R. 1 W., 10 miles northwest of Bennett, and 16 miles west of Grandin, in Carter County. The spring issues at the base of a wooded slope and flows in a small branch into Big Barren Creek. The only aquatic plants growing in the branch are milfoil and water cress.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
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BOILING SPRING

Located in sec. 33, T. 37 N., R. 10 W., four miles northeast of Hooker, Pulaski County. The water, bright blue in color, vigorously bubbles up in Gasconade River along the side of the stream. No water cress grows in the spring or around it. Aquatic plants are found only around its margins, and of these shining pondweed is commonest. The other plants are milfoil and pondweed (*Potamogeton foliosus* var. *genuinus*), of a bright green color.

LIST OF SPECIES

Shining pondweed (<i>Potamogeton lucens</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	

BOILING SPRING

Located in sec. 24, T. 32 N., R. 10 W., eight miles southwest of Licking, Texas County. The spring bubbles up on the bank and bottom of Big Piney River. In its water occurs thin grass, with blue-green leaves. This is out of place here, normally growing in woods and along stream banks. Also in and around the spring are plants of pondweed (*Potamogeton foliosus* var. *genuinus*) with firm, dark green leaves, water purslane, needle spike rush, water cress, a species of *Nitella*, and water starwort. Along the mud in a nearby slough of Big Piney River is found false pimpernel.

LIST OF SPECIES

Thin grass (<i>Agrostis perennans</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Water starwort (<i>Callitriche heterophylla</i>)
Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)	False pimpernel (<i>Lindernia dubia</i> var. <i>typica</i>)
Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)	<i>Nitella</i> sp.

BOYLERS MILL SPRING

Located in sec. 7, T. 41 N., R 19 W., at Boylers Mill, Morgan County. It rises in a circular lake basin having an area of about an

acre, and is situated in the valley of Big Buffalo Creek. The lake has quantities of shining pondweed and pondweed (*Potamogeton foliosus* var. *macellus*). The basin is deep and its bottom muddy.

A spring branch issues from the basin and flows over a dam which formerly was used to develop power for operating a mill. This branch flows in the valley next to a wooded slope. It is filled here with water cress and moss-covered rocks. It then flows, a shallow stream, only 10 feet wide, over a gravel substratum. Near its confluence with Big Buffalo Creek are beds of water speedwell, the only place in the spring where this species occurs.

LIST OF SPECIES

Shining pondweed (<i>Potamogeton lucens</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)	Water speedwell (<i>Veronica connata</i>)

BOZE MILL SPRING (Plate IV)

Located in sec. 16, T. 23 N., R. 2 W., 12 miles east of Alton, Oregon County. The main spring rises in a low swale or sink-hole basin in alluvial woods near Eleven Points River, and flows 500 feet in a short branch which has a dam built across it. The branch empties into Eleven Points River. The water of the spring in the main basin has a deep, murky, blue color. Around the margin of the spring basin are various kinds of green and blue-green algae. In order of their appearance from the margin towards the center of the basin occur water starwort, water cress, milfoil, pondweed (*Potamogeton foliosus* var. *genuinus*), water speedwell, and white water crowfoot.

From the beginning of the branch to where the dam crosses it, the water is swift-flowing. The higher plants found here are water cress with some milfoil, but most of the plants are cryptogams, comprising various algae and mosses (*Fissidens Julianus* and others), and a liverwort (*Porella pinnata*).

From the dam to the mouth of the branch are the same species previously encountered. In addition, there are slender, light green plants of a species of *Nitella*. Near the confluence of the spring branch with Eleven Points River, blue-green plants of red top grass grow in swift-running water.

At the mouth of the spring branch, at its confluence with the river, occurs a great variety of aquatic plants. In shallow, quiet water in muddy soil at the confluence are found water-weed, white water crowfoot, and pondweed (*Potamogeton foliosus* var. *macellus*). Also in the middle portion of the confluence, rooting in sandy or

gravel mud, is another assortment of aquatics, composed of milfoil, water cress, water purslane, annual bluegrass, water speedwell, water star-grass, and horned pondweed (*Zannichellia palustris* var. *major*). The last species grows here in long, light green strands, its branching resembling strands of pondweed (*Potamogeton foliosus* var. *macellus*).

This spring exhibits a larger number of species of aquatic plants than most of the Missouri springs.

LIST OF SPECIES

Water starwort (<i>Callitriche heterophylla</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Water star-grass (<i>Heteranthera dubia</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>repens</i>)
Water speedwell (<i>Veronica connata</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
White water crowfoot (<i>Ranunculus longirostris</i>)	Red top grass (<i>Agrostis stolonifera</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Liverwort (<i>Porella pinnata</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i> and var. <i>genuinus</i>)	<i>Nitella</i> sp.

BRYANT SPRING

Located at Bryant, Douglas County, in sec. 7, T. 27 N., R. 15 W., along a road about a mile west of highway No. 5. The spring rises in a valley along the slopes of a wooded hill in a quiet lake, formed by a dam. The lake has an area of about one and one-half acres. On its muddy bottom grow beds of a species of *Chara*. Towards the far head of the lake are clumps of water purslane and water plantain. Along the margin bur-reed is very common, and in the middle of the lake are quantities of water cress and green algae. A surprising feature of the spring is the total absence of milfoil, which is usually common in such springs.

The water of the spring then flows about 200 feet over a chute in a raceway to a mill which it operates, falling 16 feet in its course. This part of the spring branch is not more than 5 to 10 feet wide, especially where the current is strong and the flow rapid. It contains quantities of bur-reed, some water starwort, and olive-green strands of pondweed. All along the course of the branch water cress occurs, and in especially large quantities before the water flows over the turbine. Finally the branch empties into Bryant Creek.

LIST OF SPECIES

Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)	Milfoil (<i>Myriophyllum heterophyllum</i>)
Water plantain (<i>Alisma subcordatum</i>)	Water starwort (<i>Callitriche heterophylla</i>)
Bur-reed (<i>Sparganium americanum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	<i>Chara</i> sp.

CARTER SPRING (Plates VIII and IX)

Located in sec. 34, T. 29 N., R. 2 E., seven miles west of Piedmont, Reynolds County. The water flows from a hole in a bluff about 15 feet high, by a farmhouse. It is used to operate a water-wheel and grindstone. The spring comes from the outlet, four feet across, with a steady, gentle flow, traveling over a gravel and rock bottom. The water is about one foot deep and clear, where it comes out. Horned pondweed and water starwort grow around the edge of the basin, which is 25 feet broad and 15 feet long.

The water then flows over a concrete wall, under a shed, and down a shallow, gravelly branch. Next it flows into deeper water over a muddy bottom. Here it is filled with water starwort, water cress, and horned pondweed. Peppermint grows abundantly along the margins of the branch, and in the water is some mild water pepper. Following down the branch, one sees beds of a species of *Chara* having an olive-green or grass-green color. There is an abundance of algae all along the water. Rooting on the muddy bottom are some strands of pondweed, of a brick-brown and olive-green color.

Farther down the branch, at another place, pondweed (*Potamogeton foliosus*) becomes common and assumes a bright green color. In a place away from the current along the margin of the branch is water purslane, with an orange and olive-green cast. Here also occurs water speedwell, with a grass-green color.

After a flow of another hundred yards, the branch narrows and flows in a shallow stream, only three inches deep, over a gravel substratum. Here pondweed (*Potamogeton foliosus*) is common and of a bright green color. From this locality onward the gravel is common and the flow more rapid. Here the branch is only 10 feet wide, and the commonest plants are water speedwell and a species of *Chara*. Some other algae and pondweed (*Potamogeton foliosus*) of a bright green color occur. Water speedwell is common on the gravel, while water starwort, which was found in the beginning, is commonest on mud and in more quiet water.

In the last half of the spring branch water speedwell and water cress are the species occurring most frequently. This dominance persists as the branch empties into Webb Creek, after a flow of about 200 yards.

An interesting feature of the spring is that no water milfoil or bur-reed occurs.

LIST OF SPECIES

Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Peppermint (<i>Mentha piperita</i>)	Water speedwell (<i>Veronica connata</i>)
Pondweed (<i>Potamogeton foliosus</i>)	Mild water pepper (<i>Polygonum hydro-piperoides</i>)
Water starwort (<i>Callitriche heterophylla</i>)	<i>Chara</i> sp.
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	

CAVE SPRING

(1) Located in sec. 4, T. 30 N., R. 23 W., near Pearl, Greene County. In a well-cultivated area near a house on a grass-covered hill marginal to a valley, a small stream of water issues from a rock-lined cavity in the ground. It emerges from a low ledge of limestone rock and flows 200 feet into Asher Creek. The spring branch is small, only three feet wide, with a gravelly substratum. On its open bank it is lined along the side by limestone. The only higher water plant is water cress. Below the confluence of the spring branch with Asher Creek is found an aquatic moss.

(2) Another spring just one-eighth of a mile up Asher Creek is larger than Cave Spring, issues from a rock ledge, and flows over a gravel substratum. It has a larger branch than that of Cave Spring. In it are water cress and aquatic mosses (species of *Fissidens* and *Fontinalis*). It flows 200 feet, then empties into Asher Creek.

LIST OF SPECIES

Water cress (*Rorippa Nasturtium-aquaticum*)

CAVE SPRING (Plate V)

Located in sec. 28, T. 31 N., R. 5 W., nine miles southeast of Cedar Grove, Shannon County. "It issues from a cave at the base of a rocky cliff 40 feet high and empties into Current River 50 feet away." In the deep blue water of the spring the commonest aquatic plant is milfoil. Many aquatic mosses occur throughout the spring, and other common plants are water cress, water speedwell, and shining pondweed. All these occur rather abundantly throughout the short spring branch, to and beyond its confluence with Current River. The river is much influenced by the temperature of the water from the spring, because along the river downstream one-fourth mile from its confluence with the spring branch occur water cress, milfoil, and water speedwell. Pondweed (*Potamogeton foliosus* var. *macellus*), which was not found in the spring or spring branch, grows in the Current River rooted in gravel in shallow water one-fourth mile below the mouth of the branch.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Shining pondweed (<i>Potamogeton lucens</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)
Water speedwell (<i>Veronica connata</i>)	

CHESAPEAKE SPRING (Plate VI)

Located in the SW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 21, T. 28 N., R. 25 W., at Chesapeake, in Chesapeake State Park, Lawrence County. It issues from a gravel bed 30 feet north of highway No. 38. The spring is in a circular, rock-lined basin 25 feet in diameter and about three feet deep. It flows a small spring branch about five feet wide through a valley. The rock and gravel substratum are covered with moss. The only higher plants in the branch are horned pondweed, which occurs in dense mats, water starwort, of which there are only occasional clumps, and submerged plants of annual bluegrass. Where the spring branch enters the creek there is water cress, but none grows in the branch proper.

LIST OF SPECIES

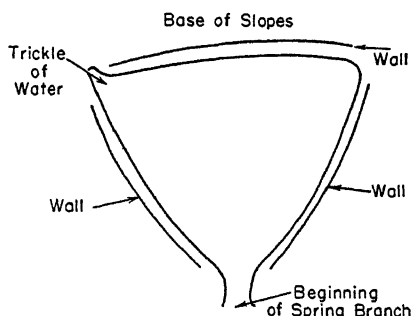
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>repans</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)

CLARKSON SPRING

Located in SE. $\frac{1}{4}$ sec. 17, T. 27 N., R. 28 W., seven miles north of Pierce City, Lawrence County. The water comes out in a small seepage by a rock wall at the base of rocky ledges among wooded, red clay slopes. A concrete wall lines the spring on both sides, forming a triangular basin. No current or flow is evident in the basin; its bottom is muddy. At one end of this triangular basin, on gravel, water cress occurs, and it is present all along the borders. Water milfoil, masses of a liverwort (*Riccia fluitans*), and aquatic mosses are also found. At first the mud is red along one end of the basin, then as one proceeds farther away from the head of the spring, gravel becomes more common. Some water starwort grows near the margins. Water milfoil is the dominant plant in the basin, forming dense masses all over the bottom. This plant has a dark bronze color. The water in some of the deeper places is clear and bluish in color.

The basin, about 300 feet wide and 200 feet long at the base of the slopes, is surrounded by a concrete wall which makes it narrower as one approaches the end of the basin and the beginning of the spring branch. Springs appear from various places on the bottom within this enclosure.

The branch which issues as an outlet from the basin is shallow, from one to six feet deep, and flows over a gravel substratum. At the beginning of the branch in swift water on gravel occur water milfoil and water starwort, while along the sides grow mostly water cress and masses of water milfoil. Next, the branch continues with mud along its margins and gravel in the rest of the stream bed. On the muddy margins grow water cress, water milfoil, a liverwort (*Riccia*



fluitans), and occasional water starwort. In the middle of the stream bed practically no higher plants are seen except an occasional clump of water cress.

The flow of the lower half of the branch is slow. At its confluence with Center Creek mostly a mud substratum occurs. Here is found only water milfoil, water cress, and a liverwort (*Riccia fluitans*).

LIST OF SPECIES

Water cress (*Rorippa Nasturtium-aquaticum*)
Milfoil (*Myriophyllum heterophyllum*)

Water starwort (*Callitriche heterophylla*)
Liverwort (*Riccia fluitans*)

COLD SPRING

Located in E. $\frac{1}{2}$ SW. $\frac{1}{4}$ sec. 4, T. 37 N., R. 1 E., near Floyd, Washington County. The water emerges as a small outlet in gravel at the head of a branch in a ravine. At this place is found water cress, bur-reed, a species of *Nitella*, and spring cress.

The water then travels down from one lake to another through a series of short falls and chutes which contain occasional plants of water cress, water starwort, and bur-reed. Around the margins of some of these lakes (formerly used as trout hatcheries), nothing is found except filamentous green algae and dark green clumps of *Nitella*.

The branch continues, bordered by a field on one side and wooded slopes on the other. Throughout this final portion of its course, no vegetation is found in the stream itself.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Bur-reed (<i>Sparganium americanum</i>)
Spring cress (<i>Cardamine bulbosa</i> f. <i>fontinalis</i>)	Water starwort (<i>Callitriche heterophylla</i>)
	<i>Nitella</i> sp.

COPPEDGE SPRING (Plate XIX)

Also called Relfe Spring, Freeman Spring, and Spring Creek Spring. It is located in sec. 36, T. 35 N., R. 10 W., at Relfe, Phelps County. The spring rises at the side of a road from a terrace-like platform, gushing forth two cascades of water over rocks covered with moss and interspersed with peppermint and water cress. The branch which emerges makes a turn and flows parallel to Spring Creek, into which it empties a short distance away.

The dominant plant in the branch is water cress. In the lower part of the branch occur some plants of white water crowfoot and water starwort. Near the confluence of the branch with Spring Creek are a few plants of peppermint.

LIST OF SPECIES

Peppermint (<i>Mentha piperita</i>)	White water crowfoot (<i>Ranunculus longirostris</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water starwort (<i>Callitriche heterophylla</i>)

CREASY SPRING (Plates VI and VII)

Also called Bubble Spring. Located in sec. 16, T. 36 N., R. 12 W., about one mile upstream from Pippin Lodge, five miles northwest of Waynesville, Pulaski County. The spring rises from a heavily wooded bank along the side of Gasconade River. Sometimes the river submerges the spring during high-water stages. The water bubbles up from a circular basin only five feet away from the river. Sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), and American elm (*Ulmus americana*), by means of their roots, hold the gravel, mud, and sand bank together; this is all that separates the spring from the river. The spring is located on the opposite side of the river and about one mile upstream from Bartlett Mill Spring and just slightly downstream from Falling Spring.

In the water of the spring, which is deep and of a gray-green color, milfoil is the commonest plant. A few plants of water cress occur

along one side of the spring, associated with some aquatic mosses and a liverwort (*Porella*).

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Liverwort (<i>Porella</i> sp.)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	

CRYSTAL SPRING

Located in sec. 22, T. 26 N., R. 15 W., at Larissa, Douglas County. The water emerges from a bed of Roubidoux sandstone boulders at the base of a hill and flows out of the gravel into a deep basin covered with sandy, gray mud. Immediately bordering the rocks, covered with moss, are plants of bur-reed.

The course of the spring is dammed by a rocky concrete wall which makes the water flow into a large basin about 200 feet long and 50 feet wide. Mats of water cress grow around the margins of the basin, associated with mats of species of *Chara*. Bur-reed is dominant all around the basin. Around its muddy margins needle spike rush and pondweed are common. Scattered on the muddy margins are dark green plants of water plantain. Most of the basin is filled with plants of water starwort and pondweed, together with quantities of milfoil.

The water next passes through a wooden chute, then flows a branch about 20 feet wide with a gravelly bottom. The branch is heavily lined with water cress. In deeper places of the branch and along its entire course in the middle are dark green mats of milfoil. The crystal-clear water in the middle of the branch flows above the substratum of gray, sandy mud. Immediately along the branch are flowering plants of speedwell or neckweed (*Veronica peregrina*).

Following down the spring branch there are found, in addition to milfoil, streaming olive-green strands of pondweed occurring in the main current, with some plants of water starwort along the margin. A small amount of bur-reed grows in the middle of the stream.

Where the branch makes a bend, are found many plants of milfoil with water starwort occurring in still water here. Lower down, milfoil becomes the dominant species.

The branch, after flowing 1,000 feet, empties into Hunter Creek.

LIST OF SPECIES

Bur-reed (<i>Sparganium americanum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water plantain (<i>Alisma subcordatum</i>)
Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)	Water starwort (<i>Callitriche heterophylla</i>)
	Milfoil (<i>Myriophyllum heterophyllum</i>)
	<i>Chara</i> sp.

DAVIDSON'S BLUE SPRING

Located along the St. Francis River, in sec. 5, T. 27 N., R. 6 E., five miles southeast of Greenville, Wayne County. The water issues at the base of a limestone bluff and forms a large basin of deep water, pale blue in color. Most of the substratum is muddy. The only aquatic plant in the spring or spring branch is horned pondweed, which grows in shallow water along the edge of the basin. There are no plants in the spring outlet proper.

The branch flows about 50 feet and empties into the St. Francis River.

LIST OF SPECIES

Horned pondweed (*Zannichellia palustris* var. *major*)

DOUBLE SPRING (Plates XIII and XIV)

Also known as Rainbow Spring. It is located in NE. $\frac{1}{4}$ NE. $\frac{1}{4}$ sec. 32, T. 24 N., R. 11 W., four miles northeast of Dormis, Ozark County. The water flows from the base of a moss-lined, semicircular slope of a wooded hill having an abundance of Roubidoux sandstone boulders. The spring gushes forth a large flow of clear water having a greenish blue color. It rushes over moss-covered boulders, making a white spray as it falls. Where the water emerges at the base of the bluff it "boils" up and forms a basin 40 feet across. Where the branch first comes out, the flow is 75 feet across. In the beginning and for the next 25 feet from the outlet occur moss-covered boulders along the margins and on the bottom. Fifty feet from the outlet the water divides into two branches, one flowing north, the other south. Growing partly in the water at the very beginning and along the margin is bitter dock, and around the head of the spring is spotted jewelweed (*Impatiens biflora*).

The left (north) branch will be described first. Twenty-five feet from the outlet along the margins are light green plants of spring cress, all submerged and growing with water milfoil and water mosses. In the deep water along the margin, away from the current, are bronze-green plants of broad-leaved pondweed, bur-reed, and water milfoil. Then at a place on the left side where the water is deep are grass-green beds of mild water pepper in masses five feet across and growing in two to four feet of water. Bur-reed, similarly, forms large mats. Now the branch is clogged with a wonderful diversity of aquatic plants—one of the richest floras to be found in the Missouri springs. All this variety and density of vegetation occurs about 40 feet from the outlet of the spring. Away from the right or left

currents and in the center of the broad spring branch are many plants of bur-reed and broad-leaved pondweed. In shallow (one foot) water are beds of water milfoil in dense mats with broad-leaved pondweed, bur-reed, horned pondweed, water-weed, and water cress. The water-weed and water cress are mostly in quiet water along the margins, while bur-reed, water milfoil, horned pondweed, and especially broad-leaved pondweed grow in the faster current.

This left branch broadens and flows north in an oblong basin about 150 yards long and 100 feet broad. Many floating as well as submerged masses of water cress dominate the branch now. The water cress occupies the shallow margins and the more quiet water between the several currents, and in these places forms dense beds. On the rest of the bottom water cress is supplanted by broad-leaved pondweed, colored bronze and russet-red and orange mixed with olive-green and dull grass-green, by bur-reed, and by water milfoil. Of these, the broad-leaved pondweed is dominant. Along the right side of the left branch, on the mud and away from the current, is water milfoil, dark green in color. It is the dominant species here and occurs with light green plants of water starwort and dark grass-green plants of water-weed. Dense beds of this water-weed are seen all along the muddy and quiet margins, and even greater quantities of water cress grow here. In the water on mud, but mostly out of water, are plants of broad-leaved arrowhead. Hornwort also is found here; it is of a dark, dull green color with light green tips.

Towards the end of this stretch of muddy water without a current are white water crowfoot, dull green plants of pondweed (*Potamogeton foliosus*) in spreading, large beds, in water six feet deep, and the broad-leaved arrowhead. This is in a bog away from the main branch along part of an old dam site.

The left branch makes several meanders around a small, grassy island covered by a few large trees of sycamore (*Platanus occidentalis*), American elm (*Ulmus americana*), walnut (*Juglans nigra*), and bitternut hickory (*Carya cordiformis*). The main branch or current follows along the extreme left side or west bank, while the slow meander with quiet water and muddy substratum, covered with white water crowfoot and hornwort, is along the east or right fork around the island. The preceding discussion of the vegetation described the right or east fork of the left branch.

Proceeding now to the left side or west bank of the left branch, where the flow is steady and the water deep, there is found on the muddy substratum large quantities of water milfoil, water-weed, and

water cress. Halfway down the branch are slightly submerged plants of mild water pepper. Proceeding towards the end of this branch, nearer the dam, water-weed is the commonest plant, occurring as large beds of dark green in water three to four feet deep. Just before reaching the dam, as the water flows into a deep pocket with a mud substratum, occur long, bronze-green strands of pondweed (*Potamogeton foliosus*). Then the water flows through holes in the wooden dam and drops two feet into the remnants of the spring branch, which now flows over a gravel substratum and is only six inches to one foot deep and about 30 feet across. In this shallow gravel stretch is water milfoil in dark green, blackish bronze, and dull bronze, prostrate mats. In one place along the margin is found water purslane with red and green or dark grass-green color. Pondweed (*Potamogeton foliosus* var. *macellus*) grows along the margin in gravel. Making prostrate growths over gravel substratum in shallow water, with the current flowing over them, are plants of bur-reed and mild water pepper. Along one side on the muddy margins are some plants of lizard's tail. Along the muddy, gravelly, shallow margins occur submerged plants of blue-green red top grass and field mint. Here also, in swift, shallow water over a gravelly bottom, along the margins, are dense, small-leaved mats of pastel green water speedwell. After flowing 700 feet, this branch enters North Fork of White River. At the confluence are beds of prostrate water milfoil, followed in lesser abundance by light green mats of water speedwell, with occasional water cress and spring cress. Away from the current and mostly in the deeper and more quiet water of the river at the confluence with this part of the spring branch are bur-reed and flowering water milfoil.

Having described the nature and distribution of the vegetation in and along the left (north) branch of Double Spring, we come to a discussion of the right (south) branch. In the beginning the stream flows over some moss-covered rocks, but soon forks around a small, rocky island. The latter is bordered with water cress, bur-reed, and broad-leaved pondweed. The bur-reed grows both in the strong current of rapid water in the submerged condition, and away from the current, where it is flowering. Farther down the branch are large quantities of water milfoil, bur-reed, and submerged bunches of water cress. This right (south) branch has a more gravelly or sandy mud substratum of a lighter color than has the left (north) branch. In this right branch now occur large, submerged beds of light green water cress, with broad-leaved pondweed, mild water pepper, and,

along the margins, water milfoil. The spring branch now maintains a steady, rapid current in a stream 100 feet wide. The flow is over a light-colored substratum with gravel and sandy mud along the margin. On some of the shallower sandy mud bottoms are light green plants of horned pondweed growing with water cress and water milfoil. On the gravelly portion of the stream bed are pale, delicate olive-green or light green, submerged and sterile plants of needle spike rush. Towards the other side, where the water is deeper and the current more swift, occur bur-reed, water cress, broad-leaved pondweed, and large quantities of water milfoil. Proceeding down the branch, the dominant species are water milfoil, water cress, bur-reed, and broad-leaved pondweed. The broad-leaved pondweed grows among the water milfoil. Here the substratum is sandy, silty mud. Along the margins grows water speedwell.

The spring branch possesses several currents and where the current is less strong in the middle, bur-reed is common and grows upright in dense colonies. Along both margins the current is stronger. Water cress is scattered throughout the course of the branch and along the right side is more or less continuous. Water milfoil forms almost continuous beds of dark bronze-green color on the left side. Water-weed occurs along the margins. In the deeper, swifter current on the right side are bur-reed, water cress, and aquatic mosses.

Proceeding downstream, we find the middle of the branch completely covered with dense beds of darker brown water milfoil. Water starwort occurs in small quantities now with hornwort and water-weed. The last is found in large quantities on a muddy substratum along the quiet margin of the left-hand side. Where hornwort and water milfoil occur side by side, they may be distinguished by certain field characters. Hornwort possesses many bushy, closely ascending branches near the tips, giving a cone-shaped appearance to the branches. Moreover, the branching occurs from all sides all along the stem. On the other hand, water milfoil has long stems, mostly unbranched, with especially long, simple, unbranched tips.

Farther down, the branch approaches the wooden wall of an old dam. About 100 yards from the dam the substratum is much muddier and from the margins inward towards the center for 20 feet occur large quantities of hornwort. It grows in long, large mats of bronze-green tipped with light, dull green. Water cress occurs with it. Some small clumps of water starwort grow in the mud along the margin. The hornwort grows best here on mud in water from four to five feet deep with a slight current, growing in clumps as much

as 10 feet long and four feet wide. Here it occurs next to the water milfoil, water cress, and water-weed, all dominant species in this part of the branch. Bur-reed is found here in insignificant, small, submerged patches only. At the dam the water is from 8 to 12 feet deep. Here are beautiful beds of hornwort, water milfoil, bur-reed with leaves three feet long, and, near the margin, water-weed.

Below the dam the water rushes from the outlet and emerges as a swift branch flowing over a gravel substratum. The branch has narrowed to 50 feet now. The dominant species here on the gravel in shallow water are water cress, mosses, and mild water pepper with grass- or olive-green, rose and red leaves in submerged condition, and green leaves in emerged condition. Most of the red color of this species is present on the lower side of the leaves and along the lower and basal leaves. In the shallow margins away from the current grows water milfoil. Farther down the branch in gravel near the margin and away from the main current are water speedwell and water milfoil. Along the left bank occurs the rare water pennywort. After flowing 300 feet from the wooden dam, and 1,500 feet from the main spring outlet, the branch enters North Fork of White River. At the confluence are water speedwell, mild water pepper, water cress, horned pondweed, water milfoil, mosses, algae, and submerged clumps of red top grass. Away from the main current occurs water milfoil.

Down river from here the plants enumerated above continue growing as a result of the influence of the temperature of the spring water on that of the river. This cool spring water is important in delimiting the occurrence of the various aquatic species which are characteristic of spring water. Water milfoil and bur-reed grow, especially along the margins. In the middle of the branch no plants occur except mosses, which cover the rocks.

LIST OF SPECIES

Bitter dock (<i>Rumex obtusifolius</i>)	White water crowfoot (<i>Ranunculus longirostris</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)	Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)
Water milfoil (<i>Myriophyllum heterophyllum</i>)	Mild water pepper (<i>Polygonum hydro-piperoides</i>)
Broad-leaved pondweed (<i>Potamogeton amplifolius</i>)	Lizard's tail (<i>Saururus cernuus</i>)
Bur-reed (<i>Sparganium americanum</i>)	Red top grass (<i>Agrostis stolonifera</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Field mint (<i>Mentha arvensis</i> var. <i>glabrata</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Water speedwell (<i>Veronica connata</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Spring cress (<i>Cardamine bulbosa</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Spring cress (<i>Cardamine bulbosa</i> f. <i>fontinalis</i>)
Broad-leaved arrowhead (<i>Sagittaria latifolia</i>)	Needle spike rush (<i>Eleocharis acicularis</i> var. <i>gracilescens</i>)
Hornwort (<i>Ceratophyllum demersum</i>)	

EBB AND FLOW SPRING

Located in NW. $\frac{1}{4}$ sec. 35, T. 27 N., R. 6 W., near Rymer's Ranch, six miles northwest of Birch Tree, Shannon County. "It issues from the base of a high hill and flows into Jacks Fork at a distance of 10 feet." The water rises quietly at the base of a small rock ledge about 15 feet high and 25 feet broad. There is no higher plant growth in the spring. The spring basin is small, only 20 feet long and 10 feet broad, and has a depth of about two feet. Its bottom is gravelly mud.

The spring flows over some large rocks and then sends a short branch 10 feet long and one foot broad over some moss-covered rocks. At its confluence with Jacks Fork the substratum is a sandy silt upon which grow in the quiet water bronze-green plants of pondweed (*Potamogeton foliosus* var. *macellus*), water milfoil, broad-leaved pondweed (*Potamogeton amplifolius*), and Ozark spatterdock. No other plants occur. The plants enumerated above do not occur in the spring branch, but grow in the river just at the confluence.

The spring is exceptional in not having at the present time water cress. It is now used as a water supply for a fishing club, and its continued use and thorough cleaning out may have led to the extermination of any water cress or any other species which may have grown there formerly. "As its name implies, the spring ebbs and flows at periodic intervals."

LIST OF SPECIES

Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)	Water milfoil (<i>Myriophyllum heterophyllum</i>)
Broad-leaved pondweed (<i>Potamogeton amplifolius</i>)	Ozark spatterdock (<i>Nuphar ozarkanum</i>)

ELM SPRING

Located in sec. 2, T. 26 N., R. 10 W., three miles southwest of Willow Springs, Howell County, in the valley of Noblett Creek. The water bubbles up in sand in a small outlet, and forms a swamp.

Around the spring grow water cress, bur-reed, water plantain, and water purslane. Water cress and bur-reed are the dominant aquatic plants in the water of the spring-fed swamp. Here also occur plants of broad-leaved pondweed.

A tiny spring branch one foot wide flows from the swamp.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Bur-reed (<i>Sparganium americanum</i>)	Broad-leaved pondweed (<i>Potamogeton amplifolius</i>)
Water plantain (<i>Alisma subcordatum</i>)	

EVANS SPRING

Located in NW. $\frac{1}{4}$ sec. 2, T. 37 N., R. 4 W., one mile southeast of Steelville, Crawford County. The water issues from the base of a high limestone bluff into a large, concrete-lined basin, and is carried in a canal to a small plant which is sometimes used to develop electric power. In the basin immediately at the base of the bluff are quantities of moss and algae. The water here is a clear blue-gray in color.

At first the spring branch used to flow out directly in front of the bluff, but concrete-lined chutes have forced its flow parallel to the bluffs into a series of basins. In these pools the naiad forms dense, brownish green to blackish mats 5 to 10 feet long. Where the water in these pools is more quiet, water starwort is common, and it and a species of *Nitella* comprise the dominant plants of the pools. There is also some water purslane here.

After leaving the pools, the spring branch begins to follow its natural course, and here water cress becomes the dominant species. The branch then flows about one mile before emptying into Yadkin Creek, but is devoid of any aquatic vegetation, except water mosses, water cress, and annual bluegrass, which are found rooting on its shallow gravel bottom.

LIST OF SPECIES

Naiad (<i>Najas guadalupensis</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>repans</i>)
Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)	<i>Nitella</i> sp.

FALLING SPRING

Located on a line between secs. 17 and 20, T. 36 N., R. 12 W., about three-fourths of a mile upstream from Pippin Lodge, five miles northwest of Waynesville, Pulaski County. It is about 200 yards upstream from Creasy Spring and on the opposite side of Gasconade River. From a circular basin about 20 feet in diameter the water rises from the base of a rocky, wooded slope covered at the base above the spring by sugar maple (*Acer saccharum* var. *glaucum*), butternut (*Juglans cinerea*), American hornbeam (*Carpinus caroliniana*), and sycamore (*Platanus occidentalis*). The water of the basin is of a dark, turbid, green color.

The only higher plant in the water of the basin is milfoil. In running, shallow water of the basin are plants of a fresh-water red alga, *Batrachyspermum*. The water next flows with ripples over five feet of gravel, then cascades over some small boulders one and one-

half feet in diameter and covered with moss. As the water falls over these boulders it makes a drop of about eight feet. Finally, it flows a spring branch 30 feet long over muddy substratum and empties into Gasconade River after a course of 150 feet from the main spring. No higher aquatic plants are found between the circular basin of the spring and its confluence with Gasconade River.

LIST OF SPECIES

Milfoil (*Myriophyllum heterophyllum*) Fresh-water red alga (*Batrachyspermum*)

GAINES FORD SPRING (Plate XIV)

Located in the NW. $\frac{1}{4}$ sec. 35, T. 39 N., R. 9 W., 10 miles northwest of Rolla, in Maries County. The water bubbles out at the base of a limestone bluff and flows a spring branch about 20 feet across, into Gasconade River—a distance of 500 feet. Around the outlet of the spring are piled up boulders of limestone and Roubidoux sandstone.

The water in the branch flows over a gravelly bottom and is one and one-half feet deep. It is bordered by moss-covered rocks. At the very beginning of the stream, rooted on the gravel substratum, are buff-brown plants of shining pondweed—the first higher aquatic plant to appear in the spring. It occurs about 25 feet from the spring outlet. Then appear along the sides quantities of dark grass-green plants of water-weed in large clumps. These grow in shallow water and on a gravel substratum.

Downstream the water becomes deeper and flows over a mud substratum. Here milfoil begins to predominate after the first 100 feet of flow, and scattered clumps of water starwort and water-weed are seen now rather frequently with the milfoil.

The two most common plants throughout the spring branch are milfoil and water-weed. Over the muddy substratum and during the last two-thirds of flow, water cress is common.

LIST OF SPECIES

Shining pondweed (*Potamogeton lucens*) Water starwort (*Callitriche heterophylla*)
Water-weed (*Anacharis occidentalis*) Water cress (*Rorippa Nasturtium-aquaticum*)
Milfoil (*Myriophyllum heterophyllum*)

GRAVEL SPRING

Located at the base of Paint Rock Bluff along Current River, sec. 4, T. 28 N., R. 1 E., 20 miles southeast of Eminence, Shannon County. The spring bubbles up from the gravel in the bed of Current River at the base of Paint Rock Bluff and spreads out in a

series of deep holes, flowing a short branch into Current River, along which it issues. In the deep water of the spring is a species of *Chara*. Other aquatic plants in the spring are milfoil, water-weed, and pondweed.

LIST OF SPECIES

Milfoil (*Myriophyllum heterophyllum*)
Water-weed (*Anacharis occidentalis*)

Pondweed (*Potamogeton foliosus* var.
genuinus)
Chara sp.

GRAVOIS MILLS SPRING (Plate XI)

Also called Collins Spring. Located in sec. 19, T. 41 N., R. 17 W., one mile west of Gravois Mills, Morgan County. It issues as a small branch, five feet broad and from four to six inches deep, coming from gravel at the head of a wooded ravine, and flows a short distance. Along its sides it is overgrown with water cress, and throughout the first part of the flow this plant is the common one. The branch broadens into a funnel-shaped basin filled with water cress growing mostly away from the current. Then the water spills over a small dam and enters a series of trout basins filled with algae. At the end of the first basin in deep quiet water are long leaves of bur-reed.

The water then rushes over a second basin and through chutes. In some of the basins with more quiet water large quantities of green algae have accumulated, and the only higher plant is bur-reed. In some basins where no other higher plants exist are dull green plants of pondweed and water cress. Both pondweed and bur-reed grow in ponds where there is not much current.

In one basin on the right side are large quantities of bur-reed growing on mud in quiet water from three to five feet deep. Here also are plants of water cress and pondweed. In another large basin next to the preceding one are plants of pondweed. In the deep basin on the right side, growing with bur-reed, water cress, and pondweed, are floating plants of hornwort and submerged ones of mild water pepper. There are also plants of the last species with stems flowering above the surface of the water.

Following down the valley one encounters the next basin, which is dammed and does not receive water from any part of the main current. Its bottom is muddy. Most of this lake (on the left side as you proceed down the valley) is filled by hornwort, while along its shallow margins in mud in quiet water grow water purslane (*Ludvigia palustris* var. *americana*), tooth-cup, and creeping love grass. The water of this lake, as previously stated, is modified spring water.

However, in the lake adjacent to it on the right side, water flows through a chute and there grow bur-reed, hornwort, and bronze-red and green plants of water purslane (*Peplis diandra*), in still water 10 to 12 feet deep. This latter basin broadens into a large lake, deep and still, with the water of a deep blue-green to deep dark green in color. On the right side this lake lies along the base of a limestone, wooded bluff, and on its sunny, exposed, muddy margin are large rose-red and brick-colored, rounded clumps of water purslane (*Peplis diandra*), olive-gray-green, submerged plants of ditch stonecrop, bur-reed, and pale green and pastel-colored plants of pondweed, with widely spreading leaves. The water from this lake then runs out from the sides of a rock dam 20 feet high and sends forth a spring branch. This branch will be described later.

In the lake on the left side occur solid beds of bronzy-green plants of pondweed. Also on the muddy margin around one lobe of the lake are solid mats of rose-red plants of tooth-cup, growing mostly out of the water. Where they are submerged, the plants are of a deep dark green color, but out of water in bright sun they assume a rose-red color. Farther out in the deep water along this side of the lake, exposed to the bright sun, grow broad-leaved pondweed with leaves of a rose-red or brick-red color mixed with brown. Here the floating leaves of this species are olive-green. Water purslane (*Peplis diandra*) also occurs here, assuming various colors according to the amount of sunlight present. For instance, in shade and along margins where growing with other plants, the leaves are dark or grass-green, but where the plants are exposed to the full rays of the sun for most of the day, the leaves assume chiefly a bright rose-red or brick-rose color. Some plants of bright rose-red-colored water purslane (*Ludvigia palustris* var. *americana*) also grow here in the sun. It is interesting to note that certain species, even though similarly exposed to the sun, never seem to turn a rose or brick color. Such species are pondweed and bur-reed, which remain shades of green, while other plants, such as water purslane (*Ludvigia palustris* var. *americana*), water purslane (*Peplis diandra*), and broad-leaved pondweed, turn to shades of rose-red or brick-red when exposed to the sun. In some of the shallow, muddy, swampy depressions along this lake are plants of pondweed, hornwort, and naiad. This is the only place in the spring where naiad grows. Along the margins here are also large quantities of water purslane (*Ludvigia palustris* var. *americana*), creeping spike rush, and tooth-cup.

This lake on the left side reaches its outlet and flows a branch coming from one of the chutes in a channel. In the beginning the

branch is narrow and deep, and flows over a muddy substratum covered mostly by bur-reed. This species grows where the water is deep and has a muddy substratum.

Going back now in the description to the outlet of the lake on the right side, the branch at the base of the rock dam proceeds over a gravelly bottom with a fast current. At first only bur-reed and water cress are seen along the margins. Then the stream becomes narrower and deeper, 20 feet broad and two feet deep, and flows over a sandy gravel substratum. Here occur bur-reed and water cress, mostly along the sides but also in the middle of the stream bed. Growing in the loose substratum are dull grass- and rich grass-green, small mats of pondweed (*Potamogeton foliosus* var. *macellus*), and plants of shining pondweed, growing only where the water is more shallow (six inches deep) and the current is rapid. Now the stream enters a basin where the flow is less rapid, and from two to three feet deep. The deeper and less rapid water at this point is caused by a flood sluice gate built across the branch, located about 50 yards downstream from the rock dam, described above. Here in deep, rather quiet water on the muddy, sand-gravel bottom are a few mats of water purslane (*Peplis diandra*) with a light, dull, grass-green color at the tips of the plants, and otherwise dark, dull green mixed with bronze or pinkish lower down and at the base of the plant. This coloring of the plants exists in shade. There are also some submerged mosses here where the bottom is of a muddy sand-gravel. Past the sluice gate this branch has a faster flow. Its course is over gravel and the water usually is only from two to six inches deep, although in places one foot deep, and from 10 to 20-feet broad. Water cress occurs along the sides and is commonest along the margins where the water is shallow and the current less swift. Some plants of bur-reed also grow along the margins and in gravel in the middle of the stream bed.

Farther down in some swift water where the main current flows over the middle of the stream bed and the stream narrows, occur bright green plants of pondweed (*Potamogeton foliosus* var. *genuinus*). After making a couple of bends the branch meets the other spring branch which came from the original source of Gravois Mills Spring, and which runs along the left (north) side as one goes downstream. The two branches unite to form a swift but narrow branch, 10 feet in width, which flows over a gravel bed. Mostly water cress occurs along the margin of the branch now. Where part of it flows over a riffle in the gravel-bed and is only one or two feet deep, are blue-green plants of fowl meadow grass. Where the rocks are larger

in this portion of the branch, they are often covered by aquatic mosses. The stream continues to flow with shallow water over a gravel substratum. In some places the water is deeper. Along the sides grow water cress, and from here on it is the only higher plant to occur until the branch flows into the Lake-of-the-Ozarks.

The left branch which originally started its flow near the head of Gravois Mills Spring at first has a gravel bottom, is narrow (five feet broad), and flows through a ditch or depression along the road. Water cress, bur-reed, pondweed (*Potamogeton foliosus* var. *genuinus*) of a bright green color, and shining pondweed with bright green leaves, occur here. The bur-reed and shining pondweed are very common. The latter occurs mostly in a shallow, swift current in the middle of the stream bed.

LIST OF SPECIES

IN SPRING WATER

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water purslane (<i>Peplis diandra</i>)
Bur-reed (<i>Sparganium americanum</i>)	Ditch stonecrop (<i>Penthorum sedoides</i>)
Hornwort (<i>Ceratophyllum demersum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i> and var. <i>genuinus</i>)
Mild water pepper (<i>Polygonum hydro-piperoides</i>)	Shining pondweed (<i>Potamogeton lucens</i>)
	Fowl meadow grass (<i>Glyceria striata</i>)

IN LAKE ON LEFT

Hornwort (<i>Ceratophyllum demersum</i>)	Water purslane (<i>Peplis diandra</i>)
Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)	Bur-reed (<i>Sparganium americanum</i>)
Tooth-cup (<i>Rotala ramosior</i> var. <i>interior</i>)	Broad-leaved pondweed (<i>Potamogeton amplifolius</i>)
Creeping love grass (<i>Eragrostis hypnoides</i>)	Pondweed (<i>Potamogeton foliosus</i>)

GREER SPRING (Plate XV)

Located in sec. 36, T. 25 N., R. 4 W., a mile north of Greer post office, and about eight miles northeast of Alton, Oregon County. "It has two outlets 300 feet apart, both of which are located in a deep, narrow gorge." At its upper outlet about one-fourth of its water issues horizontally from a cave situated at the head of a deep ravine cut in cherty dolomitic Ordovician rocks. The water is clear and cold. Around the first outlet from the cave, where the water is deep and swift-flowing, only moss grows around the rocks. The stream dashes rapidly over boulders covered with mosses and a liverwort (*Marchantia*). There are no higher plants between the first and second outlets except spring cress, which occurs along the margins away from the main current. The branch from the first outlet dashes into the second, larger outlet which "boils up" the remaining three-fourths of the water volume of the spring in a cir-

cular basin 40 feet in diameter. The water here is of steel-blue color. No plants grow in the direct force of this large volume of water, but around its margins there are various submerged mosses on the rocks. Also found here in mats are light green plants of spring cress. Dark green fowl meadow grass, some of which is submerged, occurs along the margin. Directly above this lower outlet is an American elm (*Ulmus americana*) bearing on its branches a clump of mistletoe (*Phoradendron flavescens*). A liverwort (*Dumortiera hirsuta*) grows on some of the rocks around the margin of the lower outlet.

At first the spring branch is about 30 feet broad on the average, widening in some places to 40 or 50 feet. Fifty yards from the second outlet, water cress forms a large bed along the margin away from the current, and grows from rather deep water all the way to shore. The branch dashes rapidly over moss-covered boulders and sounds like a mountain stream in the canyon. It is from two to three feet in depth here and flows over many large rocks. A liverwort (*Dumortiera hirsuta*) grows on the rocks and submerged logs in the current itself. Away from the current along the margin and at one place in the middle of the stream, behind the protection of a tree trunk which protrudes above the water and throws the current to both sides of the branch, are flowering mats of white water crowfoot. The latter and water cress are the dominant and only species of higher plants thus far.

On the north side of the branch the water is shallower, about one foot deep, and contains beds of water cress and white water crowfoot. The strands of the latter have a grass-green color, and all grow on more or less shallow, level places in the stream bed. The gravel is fine and light-colored. It is a common sight here to find masses of this species occurring as rich, dark green or grass-green mats from four to six feet long. They grow somewhat away from the main current, along the sides, but nevertheless in the actual current. Here and there are flowering clumps of water speedwell in the shallower water near the margin. Water cress grows here away from the current, but is in some deep water where it forms masses of stems, lying upon one another.

Along more quiet margins on a shallow, muddy substratum next the shore are water starwort, water pimpernel, and water cress.

Water cress lines the remainder of the flow of the spring branch. For the first one-quarter of a mile the branch has been a rough and tumbling one, then, as it becomes less rough, the species of plants mentioned above, especially white water crowfoot, become more

conspicuous and continue in prolific quantities for the last half-mile of flow.

Occasional mats of spring cress are found floating where they have become detached from rocks or attached at other places. Both the spring cress and water cress, which occurs with it in long bunches, are of a light green or grass-green color.

The branch now makes a turn to the left with a stretch of grassy meadow on the left and a steep bank on the right. Here, adjacent to the bank, is a pool with deep blue rapid-running water, while along the left side the water is shallower and flows over a light-colored gravel. The latter area receives more sunshine, which accounts for the bronze color of the mats of white water crowfoot found here. After making this bend the branch becomes 100 feet wide in places and spreads out over a shallow stream bed covered by a foot of water flowing over light-colored, small gravel. The current here is much less rapid and has few places where the water is white and foamy from cascades and waterfalls. In this shallower and slower water the bottom is covered with mats of light green water cress, and white water crowfoot with a bronze color where the sun is strong, but with a grass-green or dark green where it grows in the shade. This latter species assumes the dark green or grass-green phase along and near the shady margins. White water crowfoot is the dominant and most common species now, with water cress second in abundance.

Along the margins of the grassy meadow mentioned above grow field mint, of an olive-green or light green color, some of it slightly submerged, and mats of spotted touch-me-not (*Impatiens biflora*) among beds of water cress, and submerged, dark green, leafy, sterile plants of fowl meadow grass.

Downstream along the north side of the branch on the margin, in shade and shallow water, are olive-grass-green plants of a liverwort (*Riccia fluitans*) and duckweed.

Growing in the full sun on the stream is water speedwell, which has a light olive-green color suffused with a pastel brick or russet-brownish tinge. Again the white water crowfoot growing in the sun assumes a bronze or brown mixed with green.

Following down the lower part of the course of the branch is seen for the first time a plant of bur-reed, growing along the margins behind a bed of water cress mixed with creeping spike rush. Land plants found near the margin at this point are blue flag (*Iris virginica*), water horehound (*Lycopus rubellus*), bugle weed (*Lycopus*

virginicus), mountain mint (*Pycnanthemum virginianum*), blue lobelia (*Lobelia siphilitica*), spotted touch-me-not (*Impatiens biflora*), and *Rudbeckia palustris*.

Farther down the stream, beds of water cress cover the shallowest portions of the spring branch, to the exclusion of almost everything else. A liverwort (*Riccia fluitans*) occurs all along the quiet margins. Growing in the shallow water are bunches of water speedwell, with small leaves and short internodes, their color tinged with brick or even reddish. In grassy places water pepper (*Polygonum punctatum*) is common, in association with monkey flower (*Mimulus alatus*), water horehound (*Lycopus rubellus*), boneset (*Eupatorium perfoliatum*), false nettle (*Boehmeria cylindrica*), and willow herb (*Epilobium coloratum*). Red top (*Agrostis stolonifera*) is the chief sod-making grass. Here and there, in shallow water on gravelly substratum with water cress, occurs bitter dock (*Rumex obtusifolius*).

As the flow becomes less rapid and the water shallower, water speedwell and water cress become the commonest species. In this lower stretch of the stream are islands of water cress, where the species of the grassy, swampy meadows sometimes have their beginning. The thick beds of water cress make it possible for a large amount of detritus and silt to accumulate under a slower current, and initiates a mucky substratum in which red top grass (*Agrostis stolonifera*) and creeping spike rush (*Eleocharis calva*) can take root. When the latter have established enough of a sod, the beginning of a swampy meadow is formed, and the previously mentioned species of the swampy meadow rapidly close in upon the now available soil.

After having had broad and shallow stretches for most of its course, the branch again narrows and becomes much swifter and deeper, flowing here over some large rocks. At this point is found for the first time horned pondweed, growing here in a fast current in water one and one-half feet deep. It roots on gravel among the rocks. Its foliage is of a bright grass-green and it forms dense, prostrate, rich-colored beds in mats one to two feet long and six inches to one foot broad. Red top grass (*Agrostis stolonifera*), with a blue-green or gray-green color, occurs along gravelly margins here.

Next, as the branch becomes deeper and the current stronger, water cress disappears from most of the stream except the margins. Consequently, water speedwell and horned pondweed dominate the bottom of the stream bed, growing in patches. Along the quiet, shallow margins in sandy mud occur more clumps of bur-reed, the first seen for a quarter of a mile.

Now the branch divides around an island covered by a swampy meadow. One fork continues to flow straight, and in its shallow water are more patches of water speedwell and water cress; but the other branch curves around a bend where, on gravel in the shallow current, grows shining pondweed, with a bronze and brick color on some plants and a bright green on others. It is fully exposed to sunlight. Adjacent to this curve is a stretch of mud on one side. On it grow water cress and water speedwell, and behind them, nearer the land, bur-reed and broad-leaved arrowhead. The water is choked with beds of white water crowfoot. The muddy substratum here is due to the silty deposit made by a small spring which enters at this point and is surrounded by a swampy meadow overgrown with *Rudbeckia palustris*, *Panicum agrostoides*, and many other species. Down the remainder of the main branch, bur-reed is common along the margins. Around this small spring branch water speedwell and bronze-colored shining pondweed are dominants, with water cress and broad-leaved arrowhead occurring along the muddy margins. In muddy places here also grow white water crowfoot and water speedwell with shining pondweed. The latter species forms beds of floating leaves while some of it is in flower. Also seen along these muddy margins nearer land are creeping spike rush, rice cut grass, and knotty-leaved rush.

After the branches have forked around this island, they join in a shallow, gravelly branch about 100 feet broad. Here are abundant beds of water cress, water speedwell, and horned pondweed. A smaller amount of white water crowfoot is present. A beautiful mottled color effect is produced by the light green of water cress growing with pastel brick- and russet-colored water speedwell and light olive-green horned pondweed. The water speedwell forms large beds, while the other two species occur in lesser abundance.

Finally, the spring branch joins the Eleven Points River, after a flow of one and one-quarter miles throughout, in which it has fallen 46 feet. At the confluence the following species grow submerged: Water cress, white water crowfoot, water speedwell, and horned pondweed. The two last species are dominant here, and where the current is strongest, at the mouth of the spring branch, horned pondweed becomes the dominant species, forming large beds three or four feet long and four or five feet broad. It grows here mostly in a strong current of shallow water, rooted on the gravel, but in places the water is from two to three feet deep.

After the branch enters Eleven Points River, there are many beds of water milfoil and smaller amounts of hornwort; neither species

was found in the spring branch proper. The hornwort grows in shallow places in gravel along the river margin, while the water milfoil occurs along the margin in muddier soil, away from the current. It grows also in the river with water speedwell and white water crow-foot. On the shallow gravel away from the current are beds of water speedwell.

LIST OF SPECIES

Bitter dock (<i>Rumex obtusifolius</i>)	Shining pondweed (<i>Potamogeton lucens</i>)
Spring cress (<i>Cardamine bulbosa</i> f. <i>fontinalis</i>)	Bur-reed (<i>Sparganium americanum</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Broad-leaved arrowhead (<i>Sagittaria latifolia</i>)
White water crowfoot (<i>Ranunculus longirostris</i>)	Little duckweed (<i>Lemna minor</i>)
Water speedwell (<i>Veronica connata</i>)	Creeping spike rush (<i>Eleocharis calva</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Knotty-leaved rush (<i>Juncus acuminatus</i>)
Water pimpernel (<i>Samolus parviflorus</i>)	Fowl meadow grass (<i>Glyceria striata</i>)
Field mint (<i>Mentha arvensis</i> var. <i>glabrata</i>)	Rice cut grass (<i>Leersia oryzoides</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Liverwort (<i>Marchantia</i>)
	Liverwort (<i>Dumortiera hirsuta</i>)
	Liverwort (<i>Riccia fluitans</i>)

HAHATONKA SPRING (Plate XVI)

Located in sec. 2, T. 37 N., R. 17 W., at Hahatonka, Camden County. The outlet appears at the base of a high, limestone bluff. The color of the water is greenish gray-blue. At the very beginning, in deep water, are large beds of milfoil, alternating with water cress. Along the sides are rocks covered with algae and mosses. In the beginning the substratum is gravelly.

This deep basin of water continues for several hundred feet enclosed by wooded bluff slopes. All along the margin and in the center of the basin are long strands of milfoil, and along the deeper portions of the margin grow plants of hornwort. These two species are the only ones found in the basin. A low, narrow, wooded ridge extends towards the middle of the basin and divides the spring into two main branches. The right spring branch runs along the base of a precipitous, rocky wall and is deep. The only plants which occur in it are hornwort, milfoil, and occasionally water cress.

The left spring branch is very rich in aquatic plants. It is narrow, about 10 to 12 feet wide, and has a deep blue-gray color. Here are beds of broad-leaved, purple or green mild water pepper, bur-reed, water starwort, and water speedwell, the last very abundant. Mild water pepper grows where the current is fastest, while bur-reed occurs mostly along the margin of the branch.

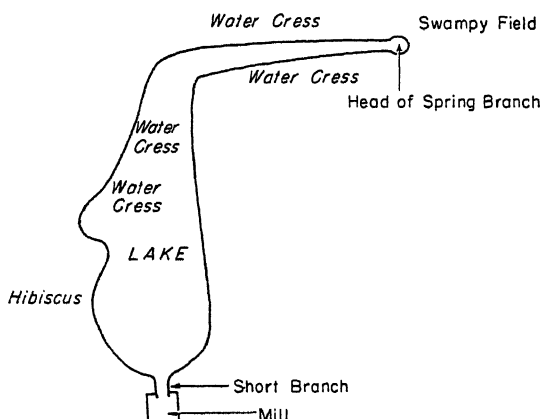
The spring empties into the Niangua River about a half-mile away from its source.

LIST OF SPECIES

Water milfoil (<i>Myriophyllum heterophyllum</i>)	Mild water pepper (<i>Polygonum hydropiperoides</i>)
Hornwort (<i>Ceratophyllum demersum</i>)	Bur-reed (<i>Sparganium americanum</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water speedwell (<i>Veronica connata</i>)
Pondweed (<i>Polamogeton foliosus</i> var. <i>genuinus</i>)	Water starwort (<i>Callitriche heterophylla</i>)

HAZLETON SPRING (Plate XVI)

Located in sec. 34, T. 33 N., R. 10 W., at Hazleton, Texas County. It rises in a 5-acre lake "formed by a dam in the spring branch, which is used to run a grist mill," and empties into Piney River 500 feet



below the mill. The lake lies in a field in a swampy section. The branch is bordered by dense masses of water cress, with which occur horned pondweed and bur-reed, and the lake is surrounded by clumps of silky willow (*Salix sericea*). The swampy ground is further inhabited by black willow (*Salix nigra*), ladies' thumb (*Polygonum lapathifolium*), panic grass (*Panicum dichotomiflorum*), swamp dock (*Rumex verticillatus*), masses of tear thumb (*Polygonum sagittatum*), and plants of swamp mallow (*Hibiscus lasiocarpus*).

The water cress grows along both sides of the spring branch, and where the latter curves around a great bend of standing water there are many plants of water starwort and masses of *Ricciocarpus* and greater duckweed.

The branch gradually widens into a long lake, at the other end of which is the grist mill. Along one side of the lake is a bay. Much swampy ground, overgrown with alder (*Alnus rugosa*), spreads around the bay. Below the bay and along one side of the lake are many plants of swamp mallow, associated with ladies' thumb and

cocklebur (*Xanthium chinense*). In this portion of the lake are many clumps of bur-reed. The chief plants of the lake, however, are water cress and water-weed. With them are associated submerged masses of *Riccia fluitans* and hornwort. Towards the end of the lake near the mill grow many plants of water-weed with milfoil and pondweed (*Potamogeton foliosus* var. *genuinus*). Plants of water purslane occur along the margin.

A short branch flows from the lake to the grist mill and then empties 500 feet below the mill.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Milfoil (<i>Myriophyllum heterophyllum</i>)
Bur-reed (<i>Sparganium americanum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)
Greater duckweed (<i>Spirodela polyrhiza</i>)	Liverwort (<i>Riccia fluitans</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Liverwort (<i>Ricciocarpus</i> sp.)

HODGSON MILL SPRING (Plate XVII)

Located in sec. 34, T. 24 N., R. 12 W., near Sycamore, Ozark County. The water, which flows from the narrow mouth of a cave, is dark green-blue in color, and about 15 feet deep. It then flows into an almost circular, rock-walled basin, about eight feet deep, 50 feet wide one way, and about 30 feet the other. In this basin occurs water starwort, water speedwell, water cress, bur-reed, and milfoil, the last species the most common. The water then flows over a dam. It has a direct fall of nine feet and the power is used by the grist mill erected nearby.

The spring branch formed is clear and swift-flowing, and about 50 feet wide. Milfoil is the dominant plant. It grows plentifully along the sides, leaving free only the narrow, clear, sandy, gravelly center of the spring branch. Scattered beds of bur-reed occur in the branch, and along the muddy bottoms are occasional clumps of water starwort, bronze-green plants of pondweed, and dark copper-red and green plants of water purslane. Most of the bur-reed is found on the left side of the spring branch. Also on the left side are occasional plants of white water crowfoot, in the mud, and plants of the fresh-water red alga, *Batrachyspermum*, which grows in the main current of the water.

Along the margin of the spring branch, and towards its confluence with Bryant Creek, occurs horned pondweed. The substratum in this portion of the branch is a yellow-gray, sandy mud. At and near

the confluence are a few plants of water star-grass. The water then flows into Bryant Creek over a ledge covered with mud from the branch.

Throughout the course of the branch milfoil predominates.

LIST OF SPECIES

Water starwort (<i>Callitriche heterophylla</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Water speedwell (<i>Veronica connata</i>)	White water crowfoot (<i>Ranunculus longirostris</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Bur-reed (<i>Sparganium americanum</i>)	Water star-grass (<i>Heteranthera dubia</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Fresh-water red alga (<i>Batrachyspermum</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)	

HOWE'S MILL SPRING

Located in sec. 15, T. 34 N., R. 3 W., at Howe's Mill, Dent County. It arises as a dammed-up lake basin filled with a species of *Chara*, water cress, pondweed, and bur-reed. The branch from the basin runs into Howe's Mill Branch, which empties into Huzzah Creek.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Bur-reed (<i>Sparganium americanum</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	<i>Chara</i> sp.

KEENER SPRING (Plates VII and VIII)

Located in sec. 9, T. 26 N., R. 5 E., one mile northwest of Keener, Butler County. The water flows from several places at the base of a brown and gray, dolomitic limestone bluff, 20 feet high. At its outlet there are only algal and moss-covered rocks. The spring is shallow but broad, since it flows from several outlets over the gravel. After flowing over shallow gravel for 20 feet with a stream bed 20 feet broad, the spring falls over a large rock pile and broadens out. In deep water away from the current at the base of the bluff and away from the outlet is flowering water milfoil.

Another spring enters the valley from the north and flows 100 feet into the same water into which the main spring flows. The former is loaded along its sides with water milfoil.

From the first rock pile, which forms a dam, the water goes over a second rock pile, then empties into a main branch which is about 40 feet wide at first. The main branch then enters a large basin and from here it commences to flow over gravel; the water is clear down the entire course.

About 100 feet down the branch the first plants of water cress occur, being found along the margins away from the main current. The branch then bends abruptly here, and water milfoil grows in the shallow current, assuming a dark green color, but red at the tips; it grows prostrate, with roots sent out from the stems into the gravel. The plant is reddish purple and green. At this bend, in shallow mud along the margin, grow water-weed, water milfoil, a little water cress, some water purslane, pondweed with a dull, pale brown color, and water milfoil, rooting in the mud and with its dissected leaves resembling milfoil (*Myriophyllum scabratum*). Along the muddy shore occur whorled loosestrife (*Lysimachia longifolia*), primrose-willow (*Jussiaea decurrens*), broad-leaved arrowhead (*Sagittaria latifolia*), and tooth-cup (*Rotala ramosior* var. *interior*).

Farther down the branch in swift-running, shallow water near the margin is a bright green pondweed in long strands. Water milfoil, in strands four feet long, is dominant and commoner than water cress, forming beds of dull bronze-green all along the margin of the stream.

On a muddy bar or "island" in the latter half of flow of the branch, along its margin mostly in mud where there is a slight current, is found horned pondweed, growing mostly loose and not in its usual dense, green mats. It has a rich, grass-green color. It occurs with water milfoil.

After flowing for 600 feet, and averaging six inches deep and 12 to 15 feet broad, the branch enters Black River.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)	Water-weed (<i>Anacharis occidentalis</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Water milfoil (<i>Myriophyllum heterophyllum</i>)

KRATZ SPRING (Plate XVII)

Located in sec. 19, T. 41 N., R. 2 W., four miles west of Stanton, Franklin County. The water bubbles up from three places in a gravel bed, forming the beginning of Spring Creek. It arises in a cultivated field. The spring makes several semicircular loops, and then forms one main branch which flows a very swift current with clear, greenish blue water over a gravel substratum. On one side of the branch is the valley; on the other side are low, wooded bluff slopes. The dominant plants of the branch are water cress and bur-reed. Quantities of moss grow on the rocks in the branch.

In the lower quarter of the branch, in a muddy place away from the main current of the spring, is a colony of water speedwell. In one deep place along the margin are plants of *Nitella*. The branch flows a distance of one-fourth mile before emptying into Spring Creek.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water speedwell (<i>Veronica connata</i>)
Bur-reed (<i>Sparganium americanum</i>)	<i>Nitella</i> sp.

MABREY SPRING

Located near the mouth of Big Barren Creek, sec. 3, T. 25 N., R. 1 E., five and one-half miles northeast of Bennett, Ripley County. The spring rises in a valley and issues from a small opening at the base of a rocky, cherty, limestone hill, flowing into a lake-like basin. Along the margin of the lake grow white water crowfoot, tooth-cup (*Rotala ramosior* var. *interior*), *Eryngium prostratum*, clammy hedge hyssop (*Gratiola lutea*), and needle spike rush. In the water of the lake occur hornwort, horned pondweed, water starwort, large-leaved pondweed, forming large colonies in the lake, milfoil, and water-weed.

From the lake a spring branch flows one-fourth mile to empty into Current River. Floating in still water of the branch are a liverwort (*Ricciocarpus*), and duckweed.

LIST OF SPECIES

White water crowfoot (<i>Ranunculus longirostris</i>)	Water starwort (<i>Callitriche heterophylla</i>)
Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)	Large-leaved pondweed (<i>Potamogeton amplifolius</i>)
Hornwort (<i>Ceratophyllum demersum</i>)	Milfoil (<i>Myriophyllum heterophyllum</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Water-weed (<i>Anacharis occidentalis</i>)
	Duckweed (<i>Lemna valdiviana</i>)
	Liverwort (<i>Ricciocarpus</i>)

MARKHAM SPRING

Located in sec. 23, T. 27 N., R. 4 E., three miles west of Williams-ville, Wayne County. "It rises in a small natural lake and empties into Black River a half-mile away." The lake is full of plants. In the deepest portion of it, near the center, the color of the water is deep blue. The commonest plant of the lake is milfoil; it has purplish red stems, and occurs in the deepest waters as well as elsewhere throughout the water. Along the deep margins grow light green plants of bur-reed, some of the plants growing in deep water and having long leaves. Dark green plants of hornwort are scattered along the margin, while along the muddy shore occur plants of creeping spike rush. Horned pondweed is rather common along the margin. Shin-

ing pondweed is very common, and occurs from near shore towards deeper water in the center.

The spring branch flowing from the lake has many aquatic plants. Water-weed, bur-reed, and needle spike rush are found commonly along the stream. On a sandy riffle exposed to the sun, where a road crosses the branch about halfway down, are plants of horned pondweed, which is found also in a slough at one end of the lake. Plants of water purslane with brownish red and green leaves occur here and there along the branch. In shaded, swift-running water, water star-grass grows in long, leafy strands, all the plants in a vegetative state with long internodes, while on sunny portions of the branch, creeping on the mud, are found flowering plants of this species with short stems and crowded internodes. Water speedwell occurs about halfway down the branch, then continues commonly as far as the confluence of the branch with Black River.

Near the confluence the water flows more slowly and runs over a more muddy substratum. In this slower water occurs Ozark spatterdock. In a slough back of the lake are plants of long-leaved pondweed (*Potamogeton americanus*), creeping on the mud, with short stems and crowded internodes, and also plants of naiad.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)
Bur-reed (<i>Sparganium americanum</i>)	Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)
Hornwort (<i>Ceratophyllum demersum</i>)	Water star-grass (<i>Heteranthera dubia</i>)
Creeping spike rush (<i>Eleocharis calva</i>)	Water speedwell (<i>Veronica connata</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Ozark spatterdock (<i>Nuphar ozarkanum</i>)
Shining pondweed (<i>Potamogeton lucens</i>)	Naiad (<i>Najas guadalupensis</i>)
Water-weed (<i>Anacharis occidentalis</i>)	

MERAMEC (MARAMEC) SPRING

Located in sec. 1, T. 37 N., R. 6 W., six miles southeast of St. James, Phelps County. "The water issues from a circular basin at the base of a rocky cliff, spreads and falls over the remains of an old rock dam, and flows swiftly down the spring branch one mile into Meramec River."

The main portion of the spring is too deep for aquatic plants, but farther down, as the water becomes shallower, strands of milfoil can be seen in the center. Along the sides of the deep portion are water cress, bur-reed, which roots in the gravel, needle spike rush, and flowering plants of the aquatic phase of annual bluegrass. Around the main, deep portion of the spring are arching limbs of American

linden (*Tilia glabra*), and along the sides are trees of hop hornbeam (*Ostrya virginiana*).

The spring then narrows into a broad branch which contains some water-weed. The branch cascades down the remains of the old rock dam, where there are green, moss-covered rocks with mats of water cress growing between them. Below the cascades occur peppermint and a liverwort (*Porella pinnata*).

At this point a small bridge crosses the spring branch, and below the bridge the shallow water flows swiftly over a gravel bottom. In the shallow stream are many moss- and algae-covered rocks, but water cress is the chief species of aquatic seed plant occurring here; it is found along the sides of the branch. Occasionally there are seen in this portion of the spring strands of milfoil and bur-reed. These latter species are found along the depositional area of the branch farthest away from the main current of the spring.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>rep-</i>
Water cress (<i>Rorippa Nasturtium-aqua-</i>	<i>tans</i>)
<i>ticum</i>)	Water-weed (<i>Anacharis occidentalis</i>)
Bur-reed (<i>Sparganium americanum</i>)	Peppermint (<i>Mentha piperita</i>)
Needle spike rush (<i>Eleocharis acicularis</i>	Liverwort (<i>Porella pinnata</i>)
var. <i>typica</i>)	

MILL CREEK SPRING

Located in sec. 19-30, T. 22 N., R. 23 W., four miles southwest of Radical, Stone County. The water rises as a small outlet in a ravine and flows a short branch 50 feet long which empties into White River. The branch flows with a smooth trickle over a gravel bottom. The only plants are water cress, pondweed, water mosses, and algae.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aqua-</i>	Water mosses
<i>ticum</i>)	Algae
Pondweed (<i>Potamogeton foliosus</i> var.	
<i>genuinus</i>)	

MILL SPRING

Located in sec. 36, T. 28 N., R. 3 E., at the town of Mill Spring, Wayne County. The water bubbles out into an oblong basin at the base of a limestone bluff near the Missouri Pacific Railroad, and is used by the company to furnish water for locomotives. The water in the basin is clear and blue. Along the margins and growing also in the water of the main spring basin, is peppermint, although the chief aquatic plants of the spring basin are russet-bronze and green clumps of water-weed, growing with shining pondweed and

a liverwort (*Porella*). Annual bluegrass and peppermint grow along the margins of the spring.

The spring branch then flows in a grassy, cultivated valley one-fourth mile before emptying into Black River. At first the branch has a gravel bottom covered in places by beds of dull greenish red water-weed, light green horned pondweed, and peppermint. Farther down, the bottom becomes more muddy. Stretches of sand alternate with mud farther along and are covered by large patches of light green horned pondweed and brown-red water-weed. Submerged plants of red top grass along the margins of the spring branch here add a blue-green cast of color to the varied greens.

Proceeding farther down the spring branch, bright olive-green plants of pondweed in long strands are found. These occur in the lower portion of the stream. Growing here in the water are plants of sour dock (*Rumex crispus*). Along the margin grows butter weed (*Senecio glabellus*). The mouth of the branch at its confluence with Black River is covered with beds of spike rush.

LIST OF SPECIES

Peppermint (<i>Mentha piperita</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)
Shining pondweed (<i>Potamogeton lucens</i>)	Spike rush (<i>Eleocharis Smallii</i>)
Annual bluegrass (<i>Poa annua</i> var. <i>rep-tans</i>)	Liverwort (<i>Porella</i> sp.)
Red top grass (<i>Agrostis stolonifera</i>)	

MILL POND

Located in sec. 18, T. 23 N., R. 15 W., at Hammond, Ozark County. The spring rises in a lake formed by the damming of two branches. Quantities of Ozark spatterdock occur all around the margins of the pond. At the far end is water purslane, while milfoil is found at the lower end of the pond. Pondweed occurs below the dam along the creek, which emerges at one end of the lake and eventually flows into Little North Fork of White River.

LIST OF SPECIES

Ozark spatterdock (<i>Nuphar ozarkanum</i>)	Milfoil (<i>Myriophyllum heterophyllum</i>)
Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)

MILLER SPRING

Located in sec. 6, T. 34 N., R. 10 W., three miles north of Big Piney post office, Pulaski County. The spring bubbles up in a more or less circular pool about 30 to 40 feet wide at the base of a wooded, cherty slope. The color of the water is a turbid green-blue. The main part of the spring is devoid of plant life, except for a few scattered plants of white water crowfoot.

The spring branch which issues forth flows through low woods of sycamore (*Platanus occidentalis*) and black willow (*Salix nigra*). At the head of the branch, where the road crosses it, are grass-green rosettes of peppermint, and following down the branch a large variety and abundance of aquatic plants are found. Here occur water starwort, water cress (not so common), water-weed, light green plants of shining pondweed, bronze-green plants of pondweed (*Potamogeton foliosus* var. *genuinus*), white water crowfoot, with dark green leaves and grass-green stems, horned pondweed occurring in long, light green strands streaming in the current in the middle of the spring branch, submerged and light green plants of water speedwell, and water purslane, which has olive-green leaves with red and orange at the tips.

At first the spring branch flows over a cherty, gravelly substratum and is shallow, with many curves. Proceeding down the branch, the substratum becomes muddy as more silt is deposited. On the deeper mud farther down the branch are some plants of mud plantain. Near the mouth of the branch in deep water are long, sterile strands of plants of water star-grass, some of whose leaves are almost 1 cm. broad. In this same area occur dark green fragments of plants of hornwort along the muddy bottom in deep water. At its confluence with Big Piney River the spring branch broadens out to 90 feet. The distance from the head to the mouth of the branch is about one-fourth mile.

Of all the species in the spring branch, the three commonest are water starwort, horned pondweed, and water-weed. A striking feature is the absence of milfoil, which is one of the commonest species of Missouri springs.

LIST OF SPECIES

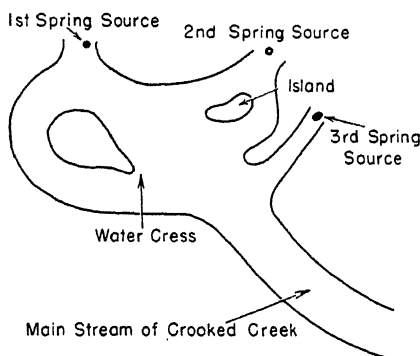
Peppermint (<i>Mentha piperita</i>)	Water speedwell (<i>Veronica connata</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Mud plantain (<i>Alisma subcordatum</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Water star-grass (<i>Heteranthera dubia</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	White water crowfoot (<i>Ranunculus longirostris</i>)
	Shining pondweed (<i>Potamogeton lucens</i>)

MONTAUK SPRING (Plate XII)

Located in SE. $\frac{1}{4}$ sec. 22, T. 32 N., R. 7 W., a half-mile north of Montauk, in Montauk State Park, Dent County. In the beginning Montauk Spring is made up of several sources which head in a low-land woods of American elm (*Ulmus americana*), while the spring sources themselves are surrounded by Ward's willow (*Salix longipes*

var. *Wardii*) and smooth alder (*Alnus rugosa*). All the sources are in basins with a gravelly substratum. One of them is in a basin covered by water cress. The basin is egg-shaped, shallow, 20 feet broad and 30 feet long, with water cress and little duckweed along the margins. Then a slight amount of spring cress is seen. Away from the main current on the right side of the branch bur-reed roots in fine, muddy, sandy silt and fine gravel. In the main current and in sandy silt there is a small amount of water speedwell.

After flowing 50 feet the branch forks on either side of an island covered with sycamore (*Platanus occidentalis*) and eventually joins the



main stream of Crooked Creek. The confluence is completely filled with water cress and spring cress, the former occurring in greater quantities and growing all along the sides as well as in the main stream bed. A small amount of white water crowfoot occurs on gravel at the confluence of this spring branch and Crooked Creek.

The right spring branch is dominated by spring cress. This branch meets another branch from the extreme right (north) side. The latter fork curves in around a bed of water cress as it meets the other branch. The water cress forms here a dense, spongy mass growing mostly over deep water. Around its head on marshy land occur spotted touch-me-not (*Impatiens biflora*) and arrow-leaved tear thumb (*Polygonum sagittatum*).

Altogether three or four main sources or branches of the spring converge. All flow out from their point of origin, join, and form a main branch 30 feet broad with a depth of one to two feet of clear, sparkling, colorless water flowing rapidly over a gravel substratum.

The main stream now makes a sweeping curve. Some submerged, blue-green plants of fowl meadow grass occur here. The branch

then tumbles rapidly over larger rocks on which are scattered dark green clumps of white water crowfoot growing in swift water a foot deep. Along the margins here occurs a slight amount of water cress.

For the first 300 yards water cress, spring cress, and white water crowfoot are the predominant growth, occurring as scattered clumps with some aquatic mosses. Along the margins farther downstream grow mostly water cress and creeping spike rush. Then the branch broadens, the water here being deep and of a clear, dull blue. Mud occurs along one side and on it grow water cress and white water crowfoot. Proceeding downstream a small amount of water starwort is found growing along the muddy margin with mosses, in three feet of water. Now, most of the bottom is muddy and the stream broadens out to 50 feet.

Then the branch again flows over gravel and here are water cress, white water crowfoot, and fowl meadow grass. Proceeding downstream another one-quarter of a mile, the same conditions continue except that the stream eventually broadens to 100 feet or more, with little or no current, flowing over a muddy bottom lined on the margin with water cress. In one to three feet of water near the muddy margin are upright, dull green and olive-bronze strands of pondweed (*Potamogeton foliosus* var. *macellus*).

The water then falls three feet over a concrete dam and continues its course downstream. Water cress is dominant now. Before crossing the road which goes to the park hotel and office, it receives another branch from the right. This branch from the right contains large quantities of pondweed (*Potamogeton foliosus* var. *macellus*) and water speedwell. It and the main branch unite and flow across the road. Rooting in the gravel in shallow water are water cress and fowl meadow grass. The latter occurs in the swift, shallow portion of the water.

There is little aquatic vegetation besides water cress from the last point farther downstream until the branch curves sharply to the left and flows along the base of the bluffs. Here it receives the spring branch of Bubbling Spring, which originates farther up the valley on the west side, and will be described later. Now there occur many plants of pondweed, water speedwell, horned pondweed, water starwort, and water cress. This branch continues downstream, becoming larger and deeper, and forms the main source of Current River.

Additional Features.—On the right side of the valley of the spring branch is Bubbling Spring, which arises as a circular pool

eight feet in diameter in a depression in a swampy meadow. The water bubbles up from a soft, gray-brown, sandy mud. Water cress immediately clogs its branch. The branch curves around from the pool and flows along limestone bluffs. A large thicket of silky willow (*Salix sericea*), *Hibiscus lasiocarpus*, and smooth alder (*Alnus rugosa*) grow in the swampy meadow here. This small branch, four feet broad and two inches to one foot in depth, flows gently over a sandy, silty bottom, its margins lined with water cress and broad-leaved arrowhead. Farther down this branch at the base of the bluffs is a slough-like part without any noticeable current, and filled with white water crowfoot. Finally, after passing this slough, the branch flows around at the base of the bluffs and empties into the main branch described above.

The other spring branch which meets the main branch just before it crosses the road leading to the park hotel and office may be described to its source as follows: It starts originally from the base of high bluffs on the west or right side of the valley, directly opposite the portion of the valley (east side) where the three or four main sources of Montauk Spring occur. However, the original source of the outlet of the spring at the base of bluffs on the west side of the valley has been dammed to form a lake of dark blue-green color, whose water is very deep. The lake is about 1,000 feet long and 200 feet broad. In it now grow in water 5 to 10 feet deep, along the sides of the slopes and bluffs, long strands of water purslane, pondweed (*Potamogeton foliosus* var. *genuinus*), and white water crowfoot. Some water cress occurs along the margin. It is the water originating from this spring source by the bluff on the west side which forms a series of lakes and hatchery ponds. Some plants of water starwort and bur-reed occur along the deep margins. Also submerged here is water cress. The original spring here has been covered from 5 to 10 feet deep. Near its head are large quantities of bur-reed. In part of the narrow, spring-fed channel, along the base of the bluffs, submerged 5 to 10 feet, occur plants of water plantain and water purslane.

After leaving the lake the water flows over a concrete dam and makes a waterfall about 25 feet high. This water forms the main right branch which flows down the valley along the main road leading through Montauk Park. It is this branch which possesses the most plentiful supply of aquatic plants. It has variations of substratum, but is mainly of a gravel type.

The branch varies in depth from six inches at the base of the fall to four or five feet in other places. Where the water is deep, it is of a green-blue color. One of the commonest plants in the branch is pondweed (*Potamogeton foliosus* var. *macellus*), with long green strands. White water crowfoot forms here solid beds three feet in length. Also common in this spring branch are submerged plants of water speedwell, in dense, light green mats. Water cress occurs along the margins and grows submerged also. In one to two feet of water are some plants of water starwort. Mats of pondweed (*Potamogeton foliosus* var. *macellus*) grow with mats of water speedwell, and plants of the latter also occur with large beds of white water crowfoot. In addition, one finds reddish or brick-colored clumps of water purslane. Occurring occasionally along the margins in deep, quiet water are floating or rooting mats of a dark green species of alga (*Chara*). The commonest plants in this branch are pondweed (*Potamogeton foliosus* var. *macellus*) and white water crowfoot.

In the fish hatcheries between the main spring-fed lake (just described in the preceding section) and the main spring branch of Montauk Spring (described in the beginning of the report) are a series of ponds with muddy bottoms. These contain submerged plants of the alga (*Chara*), and pondweed (*Potamogeton foliosus* var. *macellus*), which have mostly died owing to the rapid drainage of the ponds followed by their refilling. Here occur a variety of plants characteristic of quiet water and mud substratum, such as water plantain, false pimperl, and water purslane. Creeping spike rush is present around the margins.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i> and var. <i>genuinus</i>)
Little duckweed (<i>Lemna minor</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Spring cress (<i>Cardamine bulbosa</i> f. <i>fontinalis</i>)	Broad-leaved arrowhead (<i>Sagittaria latifolia</i>)
Bur-reed (<i>Sparganium americanum</i>)	Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)
Water speedwell (<i>Veronica connata</i>)	Water plantain (<i>Alisma subcordatum</i>)
Fowl meadow grass (<i>Glyceria striata</i>)	False pimperl (<i>Lindernia dubia</i> var. <i>typica</i>)
White water crowfoot (<i>Ranunculus longirostris</i>)	<i>Chara</i> sp.
Creeping spike rush (<i>Eleocharis calva</i>)	
Water starwort (<i>Callitriche heterophylla</i>)	

MOSSY SPRING

Located in sec. 2, T. 36 N., R. 11 W., three miles west of Hooker, Pulaski County. It rises in a field along the Gasconade River and flows a small branch three feet wide and about one-half foot deep. The water is clear and flows over a gravel substratum for a few

hundred feet. The branch empties into Gasconade River. Water cress is the only higher aquatic plant found in the water.

LIST OF SPECIES

Water cress (*Rorippa Nasturtium-aquaticum*)

OLD POND

Located in sec. 35, T. 23 N., R. 16 W., two miles southeast of Long Run, Ozark County. This is a spring-fed slough located in a valley along Pond Fork Creek, the slough fed by a small spring which issues from a low slope. In the immediate spring occurs water starwort. In the slough, which has a muddy bottom, grows a great variety of aquatic plants. Floating on the still water are lesser duckweed, greater duckweed, bladderwort, and a liverwort (*Ricciocarpus*). In the slough are milfoils, *Myriophyllum heterophyllum* and *M. scabratum*, the latter rooting along the muddy margins. Common all along the margin of the slough are quantities of bur-reed, growing with water speedwell, water purslane, and cat-tail. On the bottom are plants of a species of *Chara*. At one end of the slough is lotus. Here along the shore grow knotty-leaved rush, chairmaker's rush, and rice cut grass.

LIST OF SPECIES

Water starwort (<i>Callitriche heterophylla</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Lesser duckweed (<i>Lemna papulifera</i>)	Cat-tail (<i>Typha latifolia</i>)
Greater duckweed (<i>Spirodela polyrhiza</i>)	Lotus (<i>Nelumbo pentapetala</i>)
Bladderwort (<i>Utricularia gibba</i>)	Knotty-leaved rush (<i>Juncus acuminatus</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Chairmaker's rush (<i>Scirpus americanus</i>)
Milfoil (<i>Myriophyllum scabratum</i>)	Rice cut grass (<i>Leersia oryzoides</i>)
Bur-reed (<i>Sparganium americanum</i>)	Liverwort (<i>Ricciocarpus</i>)
Water speedwell (<i>Veronica connata</i>)	<i>Chara</i> sp.

ONANDAGO SPRING¹ (Plate XIX)

Located in sec. 35, T. 39 N., R. 3 W., five and one-half miles southeast of Leasburg, Crawford County. It rises at the base of a limestone bluff 25 feet high in a ravine and flows into a large basin filled with deep, murky blue water. The basin is 150 feet long and 60 feet wide. Along its sides the rocks are covered with masses of dirty yellow-brown and green-yellow algae. Milfoil is the common and dominant plant in the spring basin. It occurs mostly along the margins of the basin and is covered with algae. A small amount of water cress and water starwort grows along the side of the basin. Just before the water of the basin plunges over a cataract are clumps of the fresh-water red alga, *Batrachyspermum*.

¹ Sometimes spelled Onondaga.

Then the water flows as two cataracts over rocks and the resulting spring branch flows 150 feet into a small branch filled with moss-covered rocks, water cress, and water starwort. The stream then makes a sharp bend to the left and enters the valley of the Meramec River. The branch is now broad (25 feet) and has a murky, milky blue color with deep water flowing over a muddy substratum. The chief plants in the branch here are water-weed and water starwort, the latter plant here very foliose, with a broad-leaved growth throughout. Along the margin of the branch the water starwort and water cress form most of the plant growth, being conspicuous and floating along the margin. In depressions of sandy mud in the middle of the branch are occasional large colonies of dark grass-green plants of horned pondweed with fine, long leaves. Bronze-red clumps of milfoil occur along the margin. In one place, rooting in the mud, are dull olive-green plants of shining pondweed. By far the largest masses of plant growth in the spring branch are water-weed, which gives the water a black appearance wherever it occurs in large masses rooting in deep mud. A few plants of hornwort root along the muddy bottom and have a dark bronze-green color. Where the latter grows with milfoil, as it here does, the two, which resemble one another superficially, may be distinguished quickly if it is noted that the leaves of milfoil spread horizontally, while those of hornwort curve upward.

After flowing down the valley in a more or less straight course for 200 yards, the branch makes a right turn across the road, and flows for 100 feet with water cress and water starwort. It then makes another right bend, and flows into alluvial woods of river birch (*Betula nigra*) and black willow (*Salix nigra*). Here, where the branch is cluttered with brush, there is no vegetation, and it has muddy, gravelly margins. In the lower portion of its flow, the branch widens and joins the river as a slough about one-half mile long. There are no aquatic plants in this slough.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Shining pondweed (<i>Potamogeton lucens</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Fresh-water red alga (<i>Batrachyspermum</i> sp.)

PAYDOWN SPRING

Located in SW. $\frac{1}{4}$ sec. 2, T. 40 N., R. 8 W., near Paydown post office, Maries County. The spring bubbles up from the

gravel in several places along the stream bed in a lowland wooded valley dominated by Shumard oak (*Quercus Shumardii*), sycamore (*Platanus occidentalis*), shagbark hickory (*Carya ovata*), mulberry (*Morus rubra*), and American elm (*Ulmus americana*).

In the beginning the spring flows through a cover of water cress which has started growth on the gravel. One branch from the left starts out surrounded by rice cut grass, sedge (*Carex Frankii*), fowl meadow grass, honewort (*Cryptotaenia canadensis*), wood reed grass (*Cinna arundinacea*), and hog peanut (*Amphicarpa comosa*). This branch flows a narrow stream 40 feet long, lined heavily with water cress.

The other right branch begins in the gravel bed on the other side as a sort of continuation of an underground stream and for about 200 yards contains water cress, aquatic mosses, algae, and, along the edges, bur-reed. This main branch meets another spring branch which starts in the gravel bed of another part of the valley. The bur-reed roots in the gravel. The water here has a murky, gray-blue color and flows rather rapidly over a gravel bottom. As the branch continues, one finds quantities of bur-reed and water cress. The sedges (*Carex lurida*, *C. Frankii*) and common bulrush (*Scirpus atrovirens*) occur in wet soil along the banks.

This small branch then joins the main branch, which forks almost immediately at a gravelly place and runs two branches. These continue separately for 50 or 75 yards. The right branch has a slow current, while the left one has a faster current with more volume. The right branch has a liverwort (*Porella*) along its sides.

After uniting with the main spring branch, the course makes several turns. The water becomes deeper, with less current. In some places along the gravelly margins only water cress occurs, while in other portions no higher type of plant life is found. Parallel to the branch at this point is a slough of still water with a mud bottom, at the base of a hill slope. In it are quantities of milfoil and bur-reed.

Farther down the branch, rooting in the gravel along the sides as well as in the middle of the stream bed, is water speedwell. Throughout the course of the spring flow, water cress remains dominant. Annual bluegrass occurs here also, growing on the gravel in swift water, and flowering.

The water speedwell increases in abundance down the lower half of the main spring branch, growing mostly in running water

in the current in midstream. Most of it is in sterile condition, and only where the plants are growing in the more quiet margins do they flower much. Along the margins in wet, muddy ground away from the current occurs water plantain.

As the flow of water continues downstream, it becomes deep and still, and assumes a murky, gray-blue color. No higher water plants occur in some places. After making a bend around a mill, the water flows over a slightly muddy, gravel bottom. Here the branch widens and along the muddy margins away from any current is horned pondweed of a grass-green color. This plant is common here all along shallow muddy islands, bars, and margins, and in one muddy place occurs water purslane. Then the branch continues over a gravel bottom with water cress growing here and there.

On its course down the remainder of the valley, the spring branch makes several curves, in some places being much narrower than in others. There is, for the most part, no water cress here and little of any other form of higher plant life.

In places along the gravel in the current of the branch horned pondweed grows. The branch in the lowest portion of its flow is narrower than just above and below the mill, then it widens and becomes deeper just before reaching the Gasconade River around another bend. Next it grows narrower and flows swiftly over gravel, with annual bluegrass and horned pondweed. In one place water-weed occurs on gravelly mud along the margin in quiet water. The branch makes some large sweeping bends, and becomes a deep, slow, murky-muddy stream just before entering Gasconade River. Lizard's-tail (*Saururus cernuus*), monkey flower (*Mimulus alatus*), broad-leaved arrowhead (*Sagittaria latifolia*), and cocklebur (*Xanthium chinense*) occur along the banks at the confluence.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water plantain (<i>Alisma subcordatum</i>)
Bur-reed (<i>Sparganium americanum</i>)	Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Water-weed (<i>Anacharis occidentalis</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>reptans</i>)
Water speedwell (<i>Veronica connata</i>)	Liverwort (<i>Porella</i> sp.)

PHILLIPS SPRING

Also called Twin Springs. Located in sec. 10, T. 25 N., R. 1 E., 12 miles southeast of Van Buren, Carter County. The water bubbles out of the gravel as two outlets at the base of a ledge of limestone rock about four feet high. One outlet is about 10 feet in diameter,

the other 20 feet. In the portions of the outlets which are constantly bubbling up, there are no water plants.

Soon the water rushes over some gravel and moss-covered boulders. Along the side of one of the outlets are light green plants of needle spike rush and along the sides of both outlets occur purplish red plants of mild water pepper.

Away from the current of the spring water a slough is found about 50 feet downstream. In it are mild water pepper, water cress, and water-weed. Bur-reed and water cress grow in another slough near one of the outlets and about 20 feet distant from the first.

The spring branch then rushes down the valley along wooded, limestone slopes, passing swiftly over a gravelly bottom where there is very little plant growth. There are found in this part of the branch only some algae and mosses on the rocks in the current of the branch. Along the sides of the branch and away from the main current are water cress, bur-reed, and purplish red, submerged plants of mild water pepper, and on the side near the bluff is a colony of water-weed.

The branch then turns to the right and flows in a deep slough which empties into Current River. The bottom of the slough is covered with a deposit of mud and in the deeper and more quiet, clear water occur for the first time plants of shining pondweed and milfoil. Mild water pepper also is found here, while of uncommon and spotted occurrence is water speedwell. Hornwort grows plentifully on the muddy bottom in the quiet water. The plants of hornwort are of a dark green color, while nearby in places occur reddish green clumps of water purslane, with large leaves. There are only a few plants of bur-reed in the slough.

The spring branch flows about one-fourth mile before emptying into Current River.

LIST OF SPECIES

Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)	Bur-reed (<i>Sparganium americanum</i>)
Mild water pepper (<i>Polygonum hydropi- peroides</i>)	Shining pondweed (<i>Potamogeton lucens</i>)
Water cress (<i>Rorippa Nasturtium-aqua- ticum</i>)	Milfoil (<i>Myriophyllum heterophyllum</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Water speedwell (<i>Veronica connata</i>)
	Hornwort (<i>Ceratophyllum demersum</i>)
	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)

PINEY SPRING

Located in SE. $\frac{1}{4}$ sec. 4, T. 35 N., R. 8 W., one and one-half miles southeast of Yancy Mill post office, Phelps County. The spring issues from the base of a small, semicircular, limestone bluff,

the water very deep and murky blue in color. Growing in the spring is a small amount of water starwort. A spring branch then passes down the valley; its banks and bottom are muddy. The chief plant in and along the branch is water cress, and in one place is a plant of horned pondweed. The spring flows 500 feet, with very little plant life, before emptying into Little Piney River.

LIST OF SPECIES

Water starwort (<i>Callitriche heterophylla</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	

PREWETT SPRING (Plate XVIII)

Also called Mammoth Spring. Located in Pulaski County in sec. 32, T. 34 N., R. 10 W., one mile north of Edanville, Texas County. It issues from the base of a bluff and flows into Big Piney River. Around the head of the spring occur plants of mad dog skullcap (*Scutellaria lateriflora*) and willow herb (*Epilobium coloratum*). There are many moss-covered rocks in the spring, with some plants of water cress, spring cress, and water starwort.

Proceeding down the spring branch there are plants of duckweed, horned pondweed rooting in the gravel, water speedwell, water-weed, bur-reed, and in one place halfway down the branch, a clump of water starwort. Along the margins grow mild water pepper, broad-leaved arrowhead, and sticktight (*Bidens cernua*).

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water speedwell (<i>Veronica connata</i>)
Spring cress (<i>Cardamine bulbosa</i>)	Water-weed (<i>Anacharis occidentalis</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Bur-reed (<i>Sparganium americanum</i>)
Duckweed (<i>Spirodela polyrrhiza</i>)	Mild water pepper (<i>Polygonum hydropiperoides</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Broad-leaved arrowhead (<i>Sagittaria latifolia</i>)

PULLTIGHT SPRING

Located in NE. $\frac{1}{4}$ sec. 4, T. 30 N., R. 5 W., five miles south of Akers, Shannon County. "The water flows from the rocks at the base of a rocky cliff and after passing over three small dams with a combined height of about 10 feet it empties into Current River 500 feet away. The spring is located in a small valley which has a club house in it."

Along the margin of the spring proper at the base of the bluff grow water-weed and white water crowfoot, the latter species rooting in the mud. The branch which flows from the spring has quantities of water cress in it, and this plant is dominant all along the course

of the stream as far as the first spillway. Growing in masses with the water cress is the submerged aquatic state of spring cress. Other plants in the branch are milfoil, bur-reed, water starwort, and ivy-leaved duckweed. The last species is found in dense bunches.

At the base of the first spillway and along the branch to the second spillway occur milfoil, bur-reed, water cress, ivy-leaved duckweed, and spring cress. Along the shore here are spotted jewelweed (*Impatiens biflora*), boneset (*Eupatorium perfoliatum*), mad dog skullcap (*Scutellaria lateriflora*), and creeping love grass (*Eragrostis hypnoides*).

From the base of the second spillway to the confluence of the branch with Current River occur quantities of milfoil, water cress, and bur-reed. There is also some water starwort in this last branch.

LIST OF SPECIES

Water-weed (<i>Anacharis occidentalis</i>)	Spring cress (<i>Cardamine bulbosa</i> f. <i>fontinalis</i>)
White water crowfoot (<i>Ranunculus longirostris</i>)	Bur-reed (<i>Sparganium americanum</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Water starwort (<i>Callitriche heterophylla</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Ivy-leaved duckweed (<i>Lemna trisulca</i>)

RANDOLPH SPRING

Also called Flowers Spring. Located in sec. 20, T. 30 N., R. 1 E., along highway No. 21, two and one-half miles north of Ellington, Reynolds County. The spring rises in a small slough in a cultivated field in Dry Valley, next to a farm house, and empties into Logan Creek. The spring itself bubbles up in a shed. The muddy bottom of the slough is covered with water cress, water starwort, bur-reed, and bronze-green bunches of pondweed (*Potamogeton foliosus* var. *genuinus*). These are the only species represented.

The slough is about 20 to 30 feet wide, with remains of buttonbush plants (*Cephalanthus occidentalis*). The spring branch flows from the slough and contains only plants of pondweed and water cress. The branch continues across the road, becoming small, only 10 feet wide, then flows down the valley. From this point on, no more aquatic plants occur. The branch flows into Logan Creek.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Bur-reed (<i>Sparganium americanum</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)

REEDS SPRING

Also called Ball's Spring. Located in sec. 28, T. 32 N., R. 1 E., one-half mile east of Centerville, Reynolds County. The water

issues at the base of a steep, wooded hill around a cultivated slope of a hill. It comes out as a narrow stream through red clay and limestone and flows into a small basin studded with sunken limestone boulders. In some places the limestone boulders surround the basin. The water is deep, dark blue, clear, and cold. This small basin has a dam across it.

From the bottom of the basin grow plants of water starwort and pondweed (*Potamogeton foliosus* var. *genuinus*), from five to six feet long, in bright green strands. The bottom is filled with dark green bunches of a species of *Chara*. There occur also masses of algae, mosses, and a little water cress.

The water then passes out through a walled dam bank into a second deep basin and is carried out in a wooden flume to a water wheel, where power is generated to operate a grist mill and to furnish electric lights for Centerville. Where the current is swift, are long, leafy strands of water starwort. Away from the current in the deep basin are pondweed (*Potamogeton foliosus* var. *macellus*), a species of *Chara*, and some water cress. The pondweed and *Chara* occur here only where the water is deep. Then the water falls over a dam and some moss-covered rocks. Water cress and peppermint grow around these rocks.

The spring branch then flows from the water wheel across the road and makes a branch 150 feet long before emptying into the West Fork of Black River. In this part of the branch grow mosses, water cress, submerged, flowering plants of annual bluegrass, and milfoil. The last is found for the first time in this part of the spring, and occurs on gravelly mud.

The water in the last part of the spring branch becomes deep near its confluence with West Fork and no higher plant life exists.

LIST OF SPECIES

Water starwort (<i>Callitriche heterophylla</i>)	Peppermint (<i>Mentha piperita</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i> and var. <i>macellus</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>reptans</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Milfoil (<i>Myriophyllum heterophyllum</i>)
	<i>Chara</i> sp.

ROARING RIVER SPRING (Plate XVIII)

Located in sec. 27, T. 22 N., R. 27 W., seven miles south of Cassville, in Roaring River State Park, Barry County. The water issues as a strong-flowing branch from a cave at the base of a high limestone bluff, 150 to 175 feet high, the water gushing rapidly over

moss-covered boulders. Here the water is of a dark green color. Near the outlet of the cave from the bluff are dark and bright green plants of pondweed (*Potamogeton foliosus* var. *genuinus*) and water starwort.

Downstream the water becomes deeper and contains a large swaying mat, four feet long, of a species of *Nitella*. This plant continues into an artificial lake where the spring branch has been dammed. A narrow chute leads from the lake and contains pondweed (*Potamogeton foliosus* var. *genuinus*) and water starwort. Then the water rushes out over two spillways. It passes into a second lake, larger than the first artificial basin. The water in it is deep and dark green. No plants, except a slight amount of water cress, were seen in this second lake.

After leaving the lake, the water goes over a large, broad spillway and becomes a broad spring branch (about 50 feet wide). It now flows over a gravel substratum. No plants are found here. Soon the branch flows into Roaring River, but no higher plants occur at the confluence.

LIST OF SPECIES

Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Water starwort (<i>Callitriche heterophylla</i>)	<i>Nitella</i> sp.

ROARING SPRING

Located in E. $\frac{1}{2}$ sec. 19, T. 41 N., R. 1 W., two miles east of Stanton, Franklin County. The spring issues from a cave at the base of a limestone bluff 150 feet high, in a small branch which flows rapidly over limestone boulders covered with mosses and a liverwort (*Marchantia*). The branch is only four feet wide. The only higher plant besides mosses is water starwort. Most of the latter appears in mud near the confluence of the branch with the Meramec River, only 50 feet from the outlet of the branch.

LIST OF SPECIES

Liverwort (<i>Marchantia</i>)	Water starwort (<i>Callitriche heterophylla</i>)
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ROCKBRIDGE SPRING

Located in sec. 5, T. 24 N., R. 13 W., at Rockbridge, Ozark County. It has a beautiful setting, rising as a series of springs in the bed of a lake about 1,500 feet long and 400 feet wide. The lake has a deep, bluish green or brownish green color. It is formed by a dam, which develops a head of nine feet and is used to operate a mill. The dam backs up water along beautiful, wooded bluffs

on one side. The substratum in the lake is mud. The principal plants in the lake, all in still water, on the side opposite the bluff are large clumps of milfoil, with pondweed (*Potamogeton foliosus* var. *genuinus*), horned pondweed, and a species of *Chara* along the sides.

On the side of the lake along the bluff are milfoil, bur-reed, water starwort, a species of *Chara*, pondweed (*Potamogeton foliosus* var. *macellus*), and shining pondweed.

In a slough along one side the water is filled with a species of *Chara*, milfoil, white water crowfoot, water speedwell, horned pondweed, water purslane, and sweet flag.

From the dam the water falls vertically about nine feet and then rushes down to form a spring branch which flows over a gravelly bottom. Here water speedwell, bur-reed, and mosses dominate. Farther on, scarcely any aquatic plant occurs with the exception of a slight amount of moss and scattered clumps of milfoil.

Downstream, another little spring joins the main branch and here is found a rich variety of aquatic plants, comprising bur-reed, milfoil, quantities of water speedwell, dark green clumps of a species of *Nitella*, and shining pondweed.

High limestone bluffs, as one proceeds downstream, appear along one side of the spring branch, and here, besides algae and water cress, are found many plants of water speedwell, in dense mats. The water at this place rushes over large boulders in the stream.

Then the branch curves around and flows by some high, limestone bluffs that are flanked above by Roubidoux sandstone. At this point the water is deep, clear, and of a gray-blue color. Milfoil is still common, but most of the other species have disappeared.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	White water crowfoot (<i>Ranunculus longirostris</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i> and var. <i>macellus</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Sweet flag (<i>Acorus Calamus</i>)
Bur-reed (<i>Sparganium americanum</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Water starwort (<i>Callitriche heterophylla</i>)	<i>Chara</i> sp.
Shining pondweed (<i>Potamogeton lucens</i>)	<i>Nitella</i> sp.
Water speedwell (<i>Veronica connata</i>)	

ROUBIDOUX SPRING (Plate IX)

Also called Waynesville Spring. Located in sec. 25, T. 36 N., R. 12 W., one-half mile from highway No. 66, at Waynesville, Pulaski County. The water, enclosed on one side by a semicircular cement wall 20 feet high, "boils up" from the ground along the road

at the base of a high, limestone bluff. In the spring basin itself the only higher aquatic plant is milfoil.

The water then flows a branch from the basin for 50 feet before emptying into Roubidoux Creek. The water of the branch is shallow and dashes over moss-covered boulders. In the spring branch water cress and milfoil are the commonest plants, the former occurring chiefly along the margin of the branch.

At the beginning of the spring branch, near its head and along the margin, are submerged flowering plants of annual bluegrass. Farther down, also along the margin, are submerged clumps of mild water pepper with olive-green and rose-colored, lanceolate leaves which are closely matted and give the plant an appearance similar to that of water purslane. On the other side of the branch, near its junction with Roubidoux Creek, are copper or rose-green plants of water purslane, growing in close mats along the gravelly substratum.

Milfoil and water cress are the commonest plants in the spring and its branch.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Mild water pepper (<i>Polygonum hydro-</i>
Water cress (<i>Rorippa Nasturtium-aqua-</i>	<i>piperoides</i>)
<i>ticum</i>)	Water purslane (<i>Ludvigia palustris</i> var.
Bluegrass (<i>Poa annua</i> var. <i>reptans</i>)	<i>americana</i>)

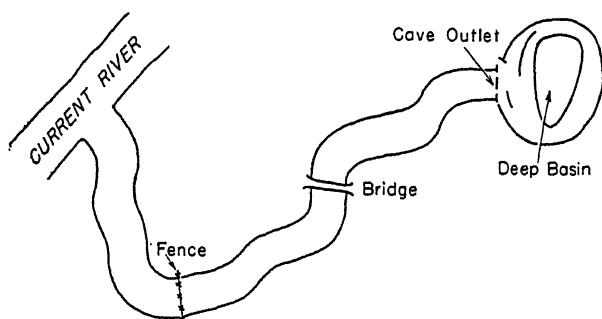
ROUND SPRING (Plates XX and XXIII)

Located in sec. 20, T. 30 N., R. 4 W., along highway No. 19, 10 miles north of Eminence, Shannon County. "The spring rises in a circular basin about 80 feet in diameter surrounded by a rock wall 30 feet high." The water in this deep hole has a prussian-blue color. The only aquatic plants here are milfoil and a small amount of water cress, both around the margin of a deep basin. The water then flows through a cave for 80 feet. Near this cave are a few plants of spring cress and rocks covered with mosses, liverworts, and green and brown flowing strands of algae.

Where the water emerges at the foot of a small hill on the other side of the cave are quantities of rocks covered with mosses and algae. Here the water is filled with many plants of milfoil coated by a growth of brown-colored algae, and water cress. Growing along the sides of the spring here are plants of knotty-leaved rush and water pimperl.

After issuing from the cave, the spring branch flows through a part of the valley and, 700 feet from its cave outlet, empties into Current River.

The occurrence and arrangement of the aquatic vegetation from the point where the spring branch emerges from the cave to where it empties into the river are as follows: The milfoil, which was observed at the outlet by the cave, continues dominant along the course of the branch. On both sides of the stream, starting 50 feet from the cave outlet, bur-reed is common. Proceeding downstream, a rocky riffle occurs and here water cress appears, associated with moss-covered rocks, and spring cress grows along the banks. It is



here that a small bridge was built across the branch. Bur-reed is common all along the margin of the branch on one side, while water cress is plentiful along the opposite margin. Milfoil is common all the way down the branch to this point.

Farther down, mats of algae-covered milfoil and water cress harbor a colony of water speedwell. Where the water becomes shallower and flows over a pure gravel bottom, water speedwell is common. Growing directly in the water of the branch are plants of the aquatic state of spring cress, with flowering stems.

Downstream is a water-gap fence where the branch turns before emptying into the river, and here where deeper water occurs grow water-weed and water starwort.

At the junction of the branch with Current River are found milfoil and water speedwell, these being the chief species occurring here. At this point the bottom of the branch is sandy and gravelly and annual bluegrass sends up flowering stalks from the water.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Water speedwell (<i>Veronica connata</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Spring cress (<i>Cardamine bulbosa</i>)
Knotty-leaved rush (<i>Juncus acuminatus</i>)	Spring cress (<i>Cardamine bulbosa</i> f. <i>fontinalis</i>)
Water pimpernel (<i>Samolus parviflorus</i>)	Water-weed (<i>Anacharis occidentalis</i>)
Bur-reed (<i>Sparganium americanum</i>)	Water starwort (<i>Callitriche heterophylla</i>)
	Bluegrass (<i>Poa annua</i> var. <i>reptans</i>)

SANDS SPRING

Located in sec. 19, T. 35 N., R. 11 W., two and one-half miles east of Tribune, Pulaski County. It arises in the bed of Gasconade River. The aquatic plants found in the river in the vicinity of the spring are hornwort, milfoil, and large-leaved pondweed.

LIST OF SPECIES

Hornwort (<i>Ceratophyllum demersum</i>)	Large-leaved pondweed (<i>Potamogeton amplifolius</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	

SCHLICHT SPRING

Located in sec. 30, T. 37 N., R. 12 W., seven miles northwest of Waynesville, Pulaski County. The spring flows from the base of a small, 25-foot, limestone bluff and into a mill pond formed by a small dam built in the spring branch. This pond is enclosed all around by a rock wall and stands at the base of a small, rounded hill. Quantities of algae border the margin of the pond, but grow chiefly towards the overflow at its farther end. A few plants of a species of *Nitella* and one plant of pondweed (*Potamogeton foliosus* var. *genuinus*) also occur in the pond, but the dominant plant is water-weed, which forms a dense, dark grass-green growth around the entire margin.

From the overflow of the pond flows a branch in which there is much water cress in the first 100 feet from the mill; after this the stream is devoid of most plants with the exception of peppermint and mosses. The lower part of this branch flows through a valley bordered by black willow (*Salix nigra*), silver maple (*Acer saccharinum*), American elm (*Ulmus americana*), and sycamore (*Platanus occidentalis*).

Part of the branch is diverted to form two large basins, dammed up by a mud bank. The basin nearest the cabin is full of algae, while the other, and the branch leading to it, are loaded with olive-gray-green, fine-leaved plants of a species of *Nitella*.

At the confluence of the branch with the Gasconade River is a small gravel bar overgrown with black willow (*Salix nigra*).

LIST OF SPECIES

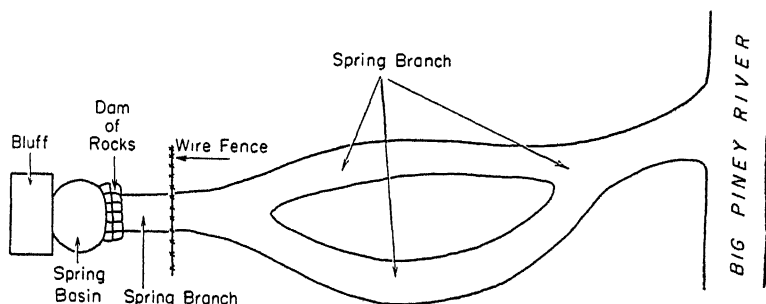
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Peppermint (<i>Mentha piperita</i>)
	<i>Nitella</i> sp.

SHANGHAI SPRING

Also called Blue Spring. Located in SW. $\frac{1}{4}$ sec. 24, T. 36 N., R. 11 W., seven miles east of Waynesville, Pulaski County. It

issues in a large, circular basin 40 feet in diameter at the base of a limestone bluff 60 feet high, and flows 1,000 feet into Big Piney River. A private clubhouse is located nearby. At the base of the bluff just above the spring basin occurs hop hornbeam (*Ostrya virginiana*), one tree on each side.

Along the margin of the basin are clumps of light green water starwort. Some plants have a bronze or coppery color, others have only a tint of this color mixed with light green. Also here are bunches of aquatic mosses and a few elongate strands of pondweed (*Potamogeton*



foliosus var. *genuinus*) and water cress. On rocks by the wall near the head of the basin are submerged flowering plants of annual blue-grass. On the bluff side of the basin is one clump of olive-green white water crowfoot. Near the farther end of this basin are submerged plants of the aquatic state of spring cress, with large elongate leaves. The color of the water in the basin where the water gently bubbles up is a dark, turbid, blue-green; around the margin of the spring it is somewhat bluer.

The water from the basin flows over five feet of rocks, forming a low dam, then rushes as a spring branch which flows 1,000 feet before emptying into Big Piney River.

Along the branch are clumps of water cress and white water crowfoot, the commonest plant of the branch. This plant is common all along the branch on a gravelly substratum. It grows in dense, circular to almost four-sided masses and has a dull olive-green color when submerged; it appears dark green when taken out of the water.

From the fence down the branch to its confluence with Big Piney River, are clumps of white water crowfoot, light green plants of bur-reed, water-weed occurring in long mats, some of which are coppery in color, and water starwort.

After crossing the road, the spring branch diverges into two prongs, the left one of which is much more prolific in vegetation, containing mostly water cress and white water crowfoot. Both branches are lined on their muddy shores with lizard's tail. Also in one area along the muddy margins of the branch, away from the current, are plants of bur-reed. The right spring branch near its confluence with the left branch contains quantities of bur-reed.

Near the junction of the branch with Big Piney River are long strands of water-weed, of dark, copper-green color. Also here in the mud away from the main current is bur-reed. At the junction are plants of water cress.

LIST OF SPECIES

Water starwort (<i>Callitriche heterophylla</i>)	White water crowfoot (<i>Ranunculus longirostris</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Spring cress (<i>Cardamine bulbosa</i> f. <i>fontinalis</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Bur-reed (<i>Sparganium americanum</i>)
Annual bluegrass (<i>Poa annua</i> var. <i>rep-tans</i>)	Water-weed (<i>Anacharis occidentalis</i>)
	Lizard's tail (<i>Saururus cernuus</i>)

SILVER LAKE

Located in sec. 1, T. 34 N., R. 9 E., at Silver Lake post office, Perry County. This spring-fed natural lake originates in the valley of Saline Creek. The water in the lake is deep and crystal-clear, and aquatic plants of various colors grow abundantly on the bottom of the basin. Milfoil forms large mats of light green and grass-green in the lake, and is very common. Other plants of the lake are a species of *Chara*, shining pondweed, a moss (*Drepanocladus aduncus*) growing in two feet of water, and hornwort, forming bronze to reddish clumps. Floating in shallower water of the lake are masses of a rare pondweed (*Potamogeton panormitanus* var. *minor*).

The spring branch flowing from the lake contains water speedwell and needle spike rush, and in slow water of the branch grows horned pondweed. Forming yellow-green mats in the branch is a moss (*Drepanocladus aduncus*).

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)
Shining pondweed (<i>Potamogeton lucens</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Hornwort (<i>Ceratophyllum demersum</i>)	Moss (<i>Drepanocladus aduncus</i>)
Pondweed (<i>Potamogeton panormitanus</i> var. <i>minor</i>)	<i>Chara</i> sp.
Water speedwell (<i>Veronica connata</i>)	

SLABTOWN SPRING (Plate XXI)

Located in sec. 15, T. 33 N., R. 10 W., five miles south of Edanville, Texas County. It emerges at the base of a rock-strewn, wooded

slope in a series of bubbles in shallow water. At the very beginning are rocks plentifully covered with mosses. Quantities of water cress grow on all sides, and in about two feet of water on one side of the spring basin are submerged plants of water starwort and horned pondweed. The water flows into an oblong basin, about 75 feet long, 30 feet wide, and three feet deep. Next it cascades and tumbles over a pile of rock, and here are many large clumps of water cress. Where the water is shallow and tumbles over rocks, mosses and algae appear. The gravel bottom is densely covered with water cress, and little else grows except a few scattered plants of water starwort.

The spring branch then flows across the road. Water cress is the chief plant here, but horned pondweed is very common, and is associated with submerged plants of annual bluegrass.

Farther down the branch is found a zonal arrangement correlated with distance from the main current. Where the main current flows, there are only rocks covered with mosses and algae, but away from the current grow horned pondweed and water cress.

Down most of the branch, which flows in a valley, at first through a field and finally through an alluvial stretch of woods, water cress is the dominant plant, but about 100 yards from the confluence of the branch with Big Piney River are clumps of water speedwell, water-weed, and bur-reed, all on a gravelly substratum.

Most of the flow of the spring branch is rapid, the water shallow, flowing over a gravelly substratum, and only 10 to 20 feet wide. It empties into Big Piney River about one-fourth mile from its outlet. The place is used as a watering area for livestock.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>repens</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Water speedwell (<i>Veronica connata</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Water-weed (<i>Anacharis occidentalis</i>)
	Bur-reed (<i>Sparganium americanum</i>)

STEELVILLE SPRING

Located in sec. 33, T. 38 N., R. 4 W., in the south part of the town of Steelville, just south of highway No. 19, Crawford County. The water issues from the base of a low, limestone bluff at the head of a ravine and emerges in an oblong basin. Water starwort is the first plant found, occurring in the very head of the spring. A straight spring branch flows from the basin and is bordered along its gravelly bottom with annual bluegrass. The water of the branch is shallow and flows mostly over a gravel substratum. Water cress then appears and remains the dominant growth until,

in a deeper place in the branch, with less rapid current, are found bur-reed, water starwort, and water cress. Along the margins of the branch grow beggar-ticks (*Bidens frondosa*), water pepper (*Polygonum punctatum*), and barnyard grass (*Echinochloa pungens*).

Farther downstream the water spreads out, becomes wider, and the bottom becomes muddier. Here water cress is commonest. At this point is the first occurrence in the spring of water-weed, and there is also some water starwort. The branch flows about 200 feet, then empties into Yadkin creek, located in Steelville.

LIST OF SPECIES

Water starwort (<i>Callitriche heterophylla</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>rep-</i>
Water cress (<i>Rorippa Nasturtium-aqua-</i>	<i>tians</i>)
<i>ticum</i>)	Bur-reed (<i>Sparganium americanum</i>)
	Water-weed (<i>Anacharis occidentalis</i>)

STONE MILL SPRING (Plate XX)

Located in Pulaski County in sec. 21, T. 35 N., R. 10 W., two miles southwest of Spring Creek post office, Phelps County. The water rises in a bubbling, whirling mass about 10 feet in diameter in a pool at the base of a semicircular arch of a wooded, limestone and moss-covered bluff. The margins of the spring proper are covered by water cress and bordered by moss-covered rocks.

The spring flows a branch 100 feet long into Big Piney River, the water clear and flowing over a gravel bottom. On its course it dashes rapidly over cascades and there are several falls. In this particular portion of the branch there are no plants except water cress and mosses.

All along the branch the shallow water flows rapidly, dashing over rocks, and only water cress occurs, but at the confluence of the spring branch with Big Piney River, where the water is one and one-half to two feet deep and not so swift, many species of water plants grow. They occur in the river itself adjacent to the mouth of the branch. Here are milfoil, water-weed, water purslane, and pondweed (*Potamogeton foliosus* var. *genuinus*). Milfoil is the commonest species, while pondweed is next commonest. Water-weed is confined to the deeper and more quiet portion of the water.

Farther away from the confluence, down the Big Piney River, a little cove away from the direct flow of the current contains milfoil, water-weed, and dark, olive- and grass-green plants of shining pondweed. The dominant plant in the water at and below the confluence is milfoil. Pondweed and water star-grass are fairly common.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Shining pondweed (<i>Potamogeton lucens</i>)
Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)	Water-weed (<i>Anacharis occidentalis</i>)
	Water star-grass (<i>Heteranthera dubia</i>)

THOMASSON MILL SPRING

Located in sec. 16, T. 22 N., R. 2 W., one-fourth mile from "The Narrows," near the confluence of Fredericks Fork with Eleven Points River, about one mile northwest of Calm, Oregon County. "The spring rises in a small lake formed by a dam at which power is developed to operate a small grist mill, and flows one-fourth mile into Eleven Points River." The lake is oblong, about 900 feet long and 200 feet wide, is quite deep, and is a deep blue-green in color in the center. It is filled mostly with long strands of milfoil. On one side, in deep mud bordering the flat margin, are water starwort, pondweed (*Potamogeton foliosus* var. *genuinus*), horned pondweed, scattered plants of water plantain, occasional clumps of water-weed, and quantities of algae. On the opposite side, along the wooded slopes, the shore is not so steep nor so abrupt. Here occur more commonly than on the other more level side, plants of water-weed, water starwort, horned pondweed, and milfoil. Near the dam the aquatic plants are very prolific, with quantities of water cress and milfoil, these two plants being the most common ones. Associated with them by the dam are also water starwort, water purslane, pondweed, and horned pondweed.

The water then flows over the rocky dam and sends forth a spring branch with a gravelly mud bottom. Here the horned pondweed is very common, appearing in long, grass-green or light green strands that wave in the current. Large beds of milfoil also occur with the horned pondweed. These two species continue as the two most common plants about halfway down the branch.

Farther down the stream on the muddy shore of one side is a bed of mild water pepper with water plantain. An occasional clump of water-weed also is found along the muddy shore.

As the branch is followed downstream, beds of milfoil are scattered all along the way. This species and reddish or bronze-green plants of mild water pepper occupy most of the substratum of the branch. The latter occurs in both a submerged and emerged state along the muddy shores.

At the confluence of the spring branch with Eleven Points River is found a variety of aquatic plants. In the deepest water at this

point and nearest the current of the river occurs milfoil. Nearer the shore in shallower water and on muddy substratum next to the main current at the confluence occur pondweed, horned pondweed, a large bed of orange and green plants of mild water pepper, red and purple water purslane, olive-green and brick-colored plants of water speedwell, water starwort, water cress, and milfoil. Along the bank are light green plants of ditch stonecrop, creeping spike rush, and rice cut grass.

LIST OF SPECIES

Milfoil (<i>Myriophyllum heterophyllum</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Mild water pepper (<i>Polygonum hydropiperoides</i>)
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Ditch stonecrop (<i>Penthorum sedoides</i>)
Water plantain (<i>Alisma subcordatum</i>)	Creeping spike rush (<i>Eleocharis calva</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Rice cut grass (<i>Leersia oryzoides</i>)

TOPAZ SPRING (Plates XXI and XXII)

Located in sec. 12, T. 26 N., R. 12 W., at Topaz, Douglas County. The water arises in a lake 150 feet in diameter. In the deepest part of the lake the water is a beautiful, deep turquoise blue. The bottom is muddy and covered with fine sand. Here occur water cress, milfoil, and olive-green plants of pondweed (*Potamogeton foliosus* var. *macellus*).

Then the water goes through a race to a mill, makes a waterfall, then sends a swift spring branch about 10 to 12 feet wide and one to one and one-half feet deep for about one-fourth mile before emptying into North Fork of White River.

Along the branch are water cress and milfoil, the latter, very common at first, growing rarer as one proceeds down the branch.

The substratum of the branch is gravel and sand. Along the margins, where the water is deeper and the substratum muddier, bur-reed occurs occasionally. Pondweed is common throughout the entire course of the stream.

The last half of the flow of the branch is dominated by rooting plants of water speedwell, which grows here in large clumps. About three-fourths of the way down the branch one clump of white water crowfoot is found, rooting in the sand in the middle of the branch.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Bur-reed (<i>Sparganium americanum</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Water speedwell (<i>Veronica connata</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)	White water crowfoot (<i>Ranunculus longirostris</i>)

TUCKER BAY SPRING

Located in sec. 3, T. 25 N., R. 1 E., five miles northeast of Bennett, Ripley County. The spring arises in a valley along the west side of Current River and flows a long branch into Current River at Tucker Bay. The branch flows along a grassy bank covered with fowl meadow grass (*Glyceria striata*), beggar-ticks (*Bidens frondosa* and *B. cernua*), water smartweed (*Polygonum punctatum*), and arrowhead (*Sagittaria latifolia*). Along the muddy banks grow lizard's tail and false pimpernel. In large masses on the gravelly bottom of the branch is the rare ivy-leaved duckweed. In the water also are found water-weed, water star-grass, in long, dense, sterile strands, pondweed (*Potamogeton panormitanus* var. *major*) in strands three feet long growing below the surface of the water, and needle spike rush, also growing under the surface in fast-flowing water. Other plants in the spring are milfoil, hornwort, and mild water pepper.

The spring branch has a blue color, and is especially dark blue as it enters Tucker Bay, where it is deep and there is less current.

LIST OF SPECIES

Lizard's tail (<i>Saururus cernuus</i>)	Water star-grass (<i>Heteranthera dubia</i>)
False pimpernel (<i>Lindernia dubia</i> var. <i>typica</i>)	Needle spike rush (<i>Eleocharis acicularis</i> var. <i>gracilescens</i>)
Ivy-leaved duckweed (<i>Lemna trisulca</i>)	Milfoil (<i>Myriophyllum heterophyllum</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Pondweed (<i>Potamogeton panormitanus</i> var. <i>major</i>)	Mild water pepper (<i>Polygonum hydropiperoides</i>)

TURKEY CREEK SPRINGS

Three small springs arise in the wooded valley of Turkey Creek, sec. 17, T. 23 N., R. 15 W., east of Hammond, Ozark County, and flow narrow branches only three to five feet wide, which run a short distance before emptying into Turkey Creek. The dominant plants are water cress and milfoil. Associated with them are shining pondweed, rooting in the gravel, and water purslane, growing in the mud.

A larger spring nearby has a good flow, and the water is deeper than that in the springs above described. In the water of this spring grow water milfoil and bur-reed, which are the dominant plants. Water speedwell occurs here only locally. There is a slight amount of shining pondweed and water purslane, but no pondweed or water-weed. In places along the branch grow peppermint, common bulrush, water pepper (*Polygonum punctatum*), and fowl meadow grass (*Glyceria striata*). The dominant shrubby plants along the branch

are heart-leaved willow (*Salix cordata*) and buttonbush (*Cephalanthus occidentalis*).

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Bur-reed (<i>Sparganium americanum</i>)
Shining pondweed (<i>Potamogeton lucens</i>)	Water speedwell (<i>Veronica connata</i>)

TURNER MILL SPRING (Plates XXII and XXIII)

Located in sec. 3, T. 24 N., R. 3 W., 10 miles northeast of Alton, Oregon County. The water flows from a cave located at the base of a high bluff, and "is carried 500 feet in a wooden flume to a water wheel which is used to operate a small lumber mill, and then flows into Eleven Points River." Where the water comes out of the bluff, it rushes over limestone boulders and rocks covered with mosses and algae. The spring branch, which flows down off the moss-covered rocks and winds around beneath the high wooden flume, has clear water flowing over a gravel and sand substratum. In it are quantities of horned pondweed, red plants of water purslane, and water starwort. Horned pondweed is the commonest of these.

Farther downstream past the mill and between the mill and Eleven Points River are horned pondweed, water speedwell, water starwort, and white water crowfoot. Quantities of the last plant are found in the last 50 feet of flow of the branch. The plants of water speedwell are olive-green, small, and rooted in gravel.

The branch for practically its entire course is about 15 feet wide, the water swift-flowing and rather shallow. The fact that the water is not deep and that it has a rapid, continuous current may explain the absence of milfoil, water-weed, and bur-reed. However, in Eleven Points River north of the confluence with the branch, many plants of milfoil occur.

LIST OF SPECIES

Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Water starwort (<i>Callitriche heterophylla</i>)
Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)	Water speedwell (<i>Veronica connata</i>)
	White water crowfoot (<i>Ranunculus longirostris</i>)

TWIN SPRINGS (Plate XXIV)

Located in sec. 11, T. 34 N., R. 4 W., 12 miles east of Salem, Dent County. The springs are in a swampy meadow of a valley. One of the springs issues from the base of a north-facing, limestone, wooded bluff and flows a branch. The other rises in a swampy meadow surrounded by clumps of Ward's willow (*Salix*

longipes var. *Wardii*) and silky willow (*Salix sericea* f. *glabra*). In grassy places around the head of the spring occur rice cut grass (*Leersia oryzoides*), common bulrush (*Scirpus atrovirens*), rush (*Juncus effusus* var. *solutus*), and water pepper (*Polygonum punctatum*). A slow, deep branch flows from the head of the spring and is covered with floating plants of bladderwort. Milfoil occurs in this still water. Ozark spatterdock grows along the margins in deep water. The surrounding shore is quite marshy and here grow Ward's willow, heart-leaved willow (*Salix cordata*), spotted cowbane (*Cicuta maculata*), buttonbush (*Cephalanthus occidentalis*), and a sedge (*Carex lurida*).

Proceeding down the branch, we find rooting on the muddy shore, as well as submerged on the bottom, plants of needle spike rush, water cress, bur-reed, pondweed (*Potamogeton foliosus* var. *genuinus*), and spring cress.

After the two spring branches meet, the united branch continues along the base of the bluffs, the water flowing over a muddy substratum. Peppermint (*Mentha piperita*), broad-leaved arrowhead (*Sagittaria latifolia*), willow herb (*Epilobium coloratum*), spike rush (*Eleocharis obtusa*), rush (*Juncus diffusissimus*), moneywort (*Lysimachia Nummularia*), mild water pepper (*Polygonum hydropiperoides*), arrow-leaved tear thumb (*Polygonum sagittatum*), and club moss (*Selaginella apus*) occur on muddy, marshy ground bordering the branch. A species of *Chara*, forming dull olive-green masses, is common along the muddy bottom. In the water of the branch occur Ozark spatterdock, water speedwell, growing both in and out of water, water purslane, bur-reed, pondweed, lying upon the muddy substratum, broad-leaved pondweed, and milfoil. Of all the plants in the main spring branch, milfoil and water cress are commonest.

LIST OF SPECIES

Bladderwort (<i>Utricularia gibba</i>)	Water purslane (<i>Ludvigia palustris</i> var. <i>americana</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Bur-reed (<i>Sparganium americanum</i>)
Needle spike rush (<i>Eleocharis acicularis</i> var. <i>gracilescens</i>)	Broad-leaved pondweed (<i>Potamogeton amplifolius</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Spring cress (<i>Cardamine bulbosa</i>)	Ozark spatterdock (<i>Nuphar ozarkanum</i>)
Ozark spatterdock (<i>Nuphar ozarkanum</i>)	<i>Chara</i> sp.
Water speedwell (<i>Veronica connata</i>)	

WARNER BAY SPRING (Plate X)

Located in sec. 9, T. 31 N., R. 2 E., six miles south of Lesterville, Reynolds County. The water issues from two separate outlets in a cave at the base of a limestone bluff, and flows a branch one-

fourth mile long before emptying into Black River. The water at the main spring is greenish and on the rocks bordering the spring are mosses, species of blue and green algae, and a liverwort. Immediately over the spring on the bluff hang plants of cat-brier (*Smilax Bona-nox*). On the bank at the beginning of the branch are plants of thyme-leaved speedwell (*Veronica serpyllifolia*), and on rocks in the branch water mosses are common.

The branch is shallow, with a gravelly substratum. In its upper half horned pondweed is common and occurs with some scattered plants of pondweed (*Potamogeton foliosus* var. *genuinus*). In the lower half of the branch the latter is dominant. In this portion of the stream there are local occurrences of water speedwell, and along the shore grows fragrant bedstraw (*Galium triflorum*).

At the confluence of the branch with Black River sterile plants of milfoil are found.

A smaller branch occurring up the valley from the main outlet of the spring, but part of the same spring, contains horned pondweed, water starwort, and bur-reed.

LIST OF SPECIES

Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	Milfoil (<i>Myriophyllum heterophyllum</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	Water starwort (<i>Callitriche heterophylla</i>)
Water speedwell (<i>Veronica connata</i>)	Bur-reed (<i>Sparganium americanum</i>)
	Liverwort (<i>Marchantia</i>)

WELCH SPRING (Plate XIII)

Located in sec. 14, T. 31 N., R. 6 W., three miles southeast of Cedar Grove, Shannon County. "The water flows out of a cave at the base of a rocky cliff and discharges into Current River 100 feet away." At the base of the bluff the water forms a fairly deep basin filled with quantities of shining pondweed, which has an olive-green color, and milfoil. Rooting in mud around the head of the spring are white water crowfoot, water starwort, water-weed, and submerged plants of slender rush. Occurring also around the main part of the spring are plants of peppermint and bur-reed.

From the main spring flow two branches, one directly to Current River 100 feet away; the other is diverted and flows through woods paralleling the river about one-eighth mile before emptying into it. In the branch which flows directly to the river are horned pondweed and water cress. In the diverted branch grow water speedwell, submerged plants of annual bluegrass, bur-reed, and water cress,

and rooting along the margins occur knotty-leaved rush and rush. In the slow water of a slough along this branch occur, rooting in the sand, false pimpernel, tooth-cup (*Rotala ramosior* var. *interior*), water plantain, *Cyperus rivularis*, and *Fimbristylis mucronulata*.

At the confluence of the diverted spring branch with Current River are found in swift water submerged plants of annual bluegrass.

LIST OF SPECIES

Shining pondweed (<i>Potamogeton lucens</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Water speedwell (<i>Veronica connata</i>)
White water crowfoot (<i>Ranunculus longirostris</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>repens</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Knotty-leaved rush (<i>Juncus acuminatus</i>)
Water-weed (<i>Anacharis occidentalis</i>)	Rush (<i>Juncus Dudleyi</i>)
Slender rush (<i>Juncus macei</i>)	False pimpernel (<i>Lindernia dubia</i> var. <i>typica</i>)
Peppermint (<i>Mentha piperita</i>)	Water plantain (<i>Alisma subcordatum</i>)
Bur-reed (<i>Sparganium americanum</i>)	
Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)	

WESTOVER SPRING

Located in SW. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 14, T. 37 N., R. 3 W., at Westover, Crawford County. The spring emerges from several sources within an area of about two acres. The main branch issues near Dry Creek in a low field surrounded by woods, flows into a marshy lake, curves around an island, then spreads out into a broad stream filled with water cress, bur-reed, milfoil, water starwort, and pondweed (*Potamogeton foliosus* var. *genuinus*). These are the main plants found throughout the course of the branch.

Down the stream are seen occasionally plants of hornwort, shining pondweed, and a species of *Nitella*.

The water is then turned into a series of chutes for a trout hatchery, where the dominant plant is milfoil. Other plants associated with it are horned pondweed, which is seen only occasionally in the branch, bur-reed, long strands of dark bronze-green pondweed, and an occasional light green clump of water speedwell.

The water ends at a mill, and pours out into Dry Creek, which empties eventually into Huzzah Creek.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Bur-reed (<i>Sparganium americanum</i>)	Shining pondweed (<i>Potamogeton lucens</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Horned pondweed (<i>Zannichellia palustris</i> var. <i>major</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Water speedwell (<i>Veronica connata</i>)
Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)	<i>Nitella</i> sp.

WILDER SPRING (Plate X)

Also called Breakup Spring. Located in sec. 14, T. 23 N., R. 11 W., on the Kelly-Wilder Ranch, six miles north of Elijah, Ozark County. The spring bubbles out in a series of small, moss-lined springs at the base of low, wooded, southwest-facing, rock bluffs in the channel of Spring Creek. Moss and algae cover the rocks, while water cress is the chief flowering plant. The spring flows along the rock ledge over a broad, gravelly bottom and forms a branch, the water here being deep sky-blue in color. In this deeper water of the branch milfoil is dominant and is almost the only plant growth, except mosses and algae. Bur-reed and white water crow-foot occur in occasional clumps.

Farther down the branch, before it makes a turn, a great variety of aquatic flowering plants is found. Here are clumps of water speedwell of an olive-green color, water starwort, pondweed (*Potamogeton foliosus* var. *macellus*), of a dark, bronze-green color, and dark green plants of *Nitella*, growing in close clusters. These are interspersed with quantities of milfoil and aquatic mosses, which grow in the dashing water of the branch.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water speedwell (<i>Veronica connata</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Water starwort (<i>Callitriche heterophylla</i>)
Bur-reed (<i>Sparganium americanum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)
White water crowfoot (<i>Ranunculus longirostris</i>)	<i>Nitella</i> sp.

WILKINS SPRING

Located in S. $\frac{1}{2}$ SE. $\frac{1}{4}$ sec. 17, T. 36 N., R. 9 W., seven miles southwest of Newburg, Phelps County. "It rises in a 2-acre lake formed by an earth dam, flows down the valley 1,000 feet, and empties into Mill Creek." The circular basin in which the spring rises is bordered by rocks and a concrete wall. Here occur aquatic mosses, hornwort, with a dark brown and blackish green color, mild water pepper, a species of *Riccia*, water starwort, needle spike rush, bur-reed in deeper water but still around the margin, and water cress, both around the edge and in the center of the basin.

From the main part of the spring flows the branch, which curves around a low meadow in the valley of Mill Creek. In and along the branch are quantities of water cress, bur-reed, and long strands of pondweed (*Potamogeton foliosus* var. *genuinus*) with dark green and bronze leaves. The dominant plants in the branch are water cress

and pondweed. Other plants occurring, but much rarer, are submerged flowering annual bluegrass with bluish green leaves, duckweed, and a species of *Riccia*, both of which are found along the more quiet margins of the branch, needle spike rush, growing on the sand along the branch, and water purslane, which was found in only one place about halfway down the branch. It has very large and long, olive-green leaves tinged with bronze and orange.

In the lower portion of the branch grow water cress, pondweed, bur-reed, and water starwort, which is quite rare here. Water cress and bur-reed are the commonest plants all along the branch.

LIST OF SPECIES

Hornwort (<i>Ceratophyllum demersum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)
Mild water pepper (<i>Polygonum hydropiperoides</i>)	Annual bluegrass (<i>Poa annua</i> var. <i>repens</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Duckweed (<i>Spirodela polyrrhiza</i>)
Needle spike rush (<i>Eleocharis acicularis</i> var. <i>typica</i>)	Water purslane (<i>Ludwigia palustris</i> var. <i>americana</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	<i>Riccia</i> sp.
Bur-reed (<i>Sparganium americanum</i>)	

WILLIAMS SPRING

Located in sec. 34, T. 25 N., R. 1 E., in a valley tributary to Current River, near Pike Slough, on the east side of the river, southwest of Grandin, Ripley County. The spring rises at the base of a wooded slope and flows a small branch containing water-weed, water starwort, water speedwell, bur-reed, and water cress. After flowing several hundred feet, the stream empties into Current River.

LIST OF SPECIES

Water-weed (<i>Anacharis occidentalis</i>)	Bur-reed (<i>Sparganium americanum</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Water cress (<i>Rorippa Nasturtium-aquaticum</i>)
Water speedwell (<i>Veronica connata</i> var. <i>glaberrima</i>)	

WOODS LAKE

Located in sec. 24, T. 37 N., R. 1 W., one mile south of Berryman, Washington County. This lake is spring-fed, has a dark green color, and varies from one to ten feet in depth. It is an old meander cut off from the main course of Courtois Creek. The aquatic plants found in it are water cress, milfoil, hornwort, water starwort, and large-leaved pondweed. In deep water grow grass-green plants of pondweed (*Potamogeton foliosus* var. *genuinus*) and Ozark spatterdock.

LIST OF SPECIES

Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Large-leaved pondweed (<i>Potamogeton amplifolius</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>genuinus</i>)
Hornwort (<i>Ceratophyllum demersum</i>)	Ozark spatterdock (<i>Nuphar ozarkanum</i>)
Water starwort (<i>Callitriche heterophylla</i>)	

YANCY MILL SPRING

Located in SW. $\frac{1}{4}$ sec. 32, T. 36 N., R. 8 W., at Yancy Mill post office, Phelps County. "The water bubbles up in a gravel bed, which is surrounded by a low wall and dam," and empties into Little Piney River.

In the spring at the very beginning is an abundance of needle spike rush, water cress, water starwort, a small amount of milfoil, and some aquatic mosses (*Fontinalis* and other genera). The spring branch which flows from the spring across the road and into Little Piney River has an abundance of water cress, water starwort, and olive-green strands of pondweed (*Potamogeton foliosus* var. *macellus*). Of these plants water cress is dominant and by far the commonest.

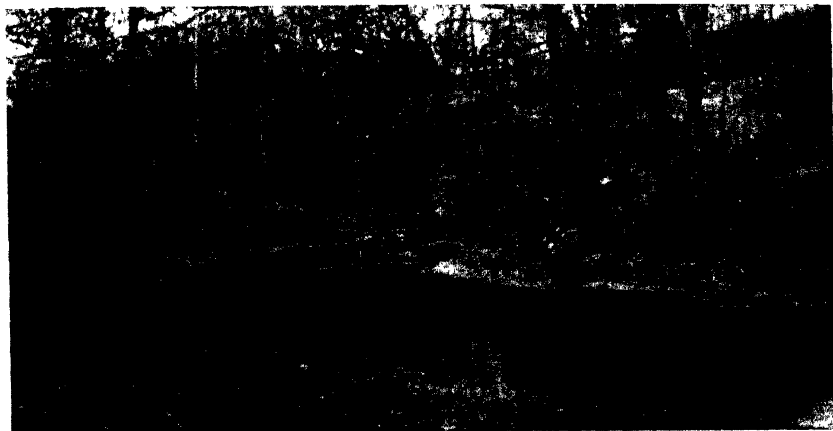
Along the Big Piney River near its confluence with the branch are water cress, water-weed, and a species of *Chara*.

Another part of the flow from the spring has been dammed to form a large lake bordered by a rocky, wooded slope on one side, and on the other by an alluvial field. Most of the lake is overgrown with a species of *Chara*, having a dull, olive-green color, and water-weed is common along the margin. The other aquatic plants in the lake are hornwort, milfoil, and least duckweed, the last a rare species, floating among the dead leaves and algae on the surface of the water. Around the margin are alder (*Alnus rugosa*), heart-leaved willow (*Salix cordata*), and aster (*Aster lateriflorus* var. *pendulus*).

At the far end of the lake, back of the dam wall, is an outlet from the mill, which forms a small branch loaded with water plants. Here are quantities of water cress and milfoil, short-stemmed, dark green plants of pondweed, and water-weed.

LIST OF SPECIES

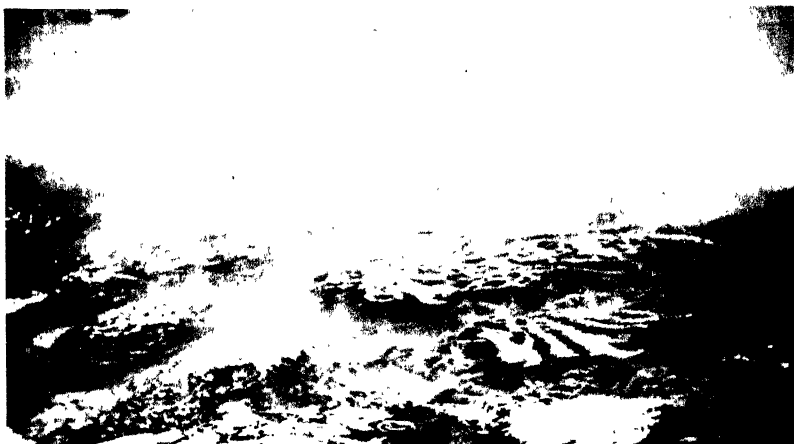
Needle spike rush (<i>Eleocharis acicularis</i> var. <i>gracilescens</i>)	Pondweed (<i>Potamogeton foliosus</i> var. <i>macellus</i>)
Water cress (<i>Rorippa Nasturtium-aquaticum</i>)	Water-weed (<i>Anacharis occidentalis</i>)
Water starwort (<i>Callitriche heterophylla</i>)	Hornwort (<i>Ceratophyllum demersum</i>)
Milfoil (<i>Myriophyllum heterophyllum</i>)	Least duckweed (<i>Wolffia punctata</i>)
	Aquatic mosses (<i>Fontinalis</i>)
	<i>Chara</i> sp.



ALTHEA SPRING, OZARK COUNTY
Spring branch near confluence with North Fork of White River



BENNETT SPRING, LACLEDE COUNTY



BIG SPRING, CARTER COUNTY

Part of spring branch, showing mats of *Myriophyllum heterophyllum*



BIG SPRING, CARTER COUNTY



BIG SPRING, LAWRENCE COUNTY



BIG SPRING, CARTER COUNTY



BLUE SPRING, LACLEDE COUNTY



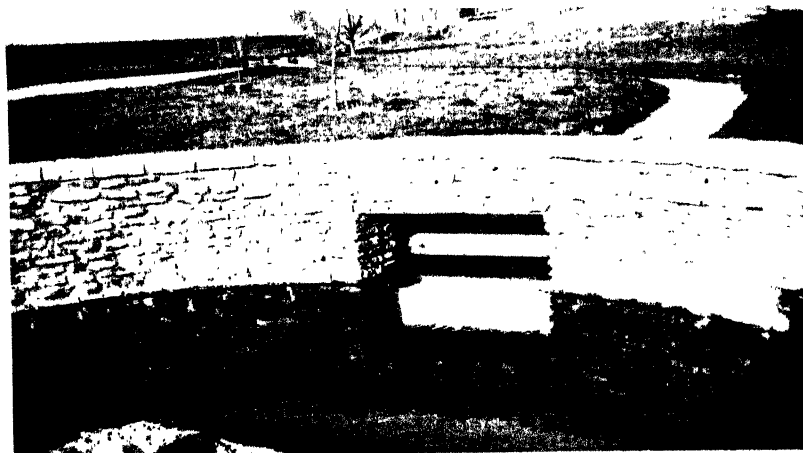
BOZE MILL SPRING, OREGON COUNTY



BLUE SPRING, OREGON COUNTY



CAVE SPRING, SHANNON COUNTY
Head of spring



CHESAPEAKE SPRING, LAWRENCE COUNTY



CREASY SPRING, PULASKI COUNTY



CREASY SPRING, PULASKI COUNTY



KEENER SPRING, BUTLER COUNTY
Head of spring



KEENER SPRING, BUTLER COUNTY
Head of spring



CARTER SPRING, REYNOLDS COUNTY
Head of spring



CARTER SPRING, REYNOLDS COUNTY
Narrow lower part of spring branch



WAYNESVILLE SPRING, PULASKI COUNTY
Head of spring



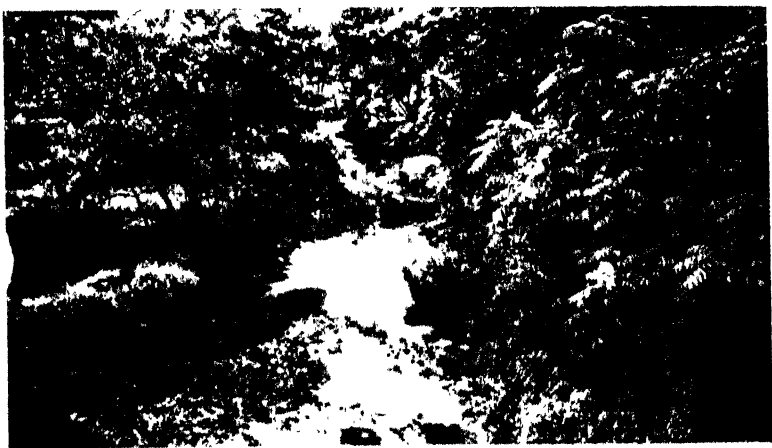
WARNER BAY SPRING, REYNOLDS COUNTY
Head of spring



WILDER SPRING, OZARK COUNTY



GRAVOIS MILLS SPRING, MORGAN COUNTY
One of spring-fed basins



GRAVOIS MILLS SPRING, MORGAN COUNTY
Lower part of spring branch



MONTAUK SPRING, DENT COUNTY

One of heads of spring, showing island of *Rorippa Nasturtium-aquaticum*

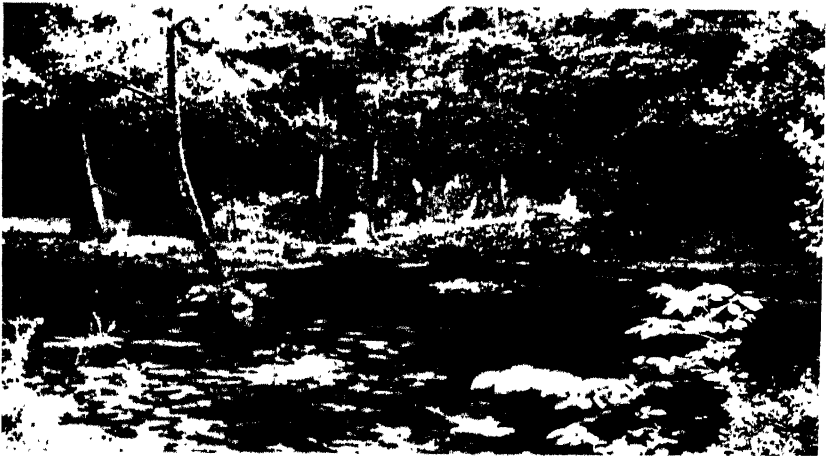


MONTAUK SPRING, DENT COUNTY

Junction of spring heads



WELCH SPRING, SHANNON COUNTY
Head of spring



DOUBLE SPRING, OZARK COUNTY
Head of spring



DOUBLE SPRING, OZARK COUNTY



GAINES FORD SPRING, MARIES COUNTY
Head of spring



GREER SPRING, OREGON COUNTY
Upper outlet of spring



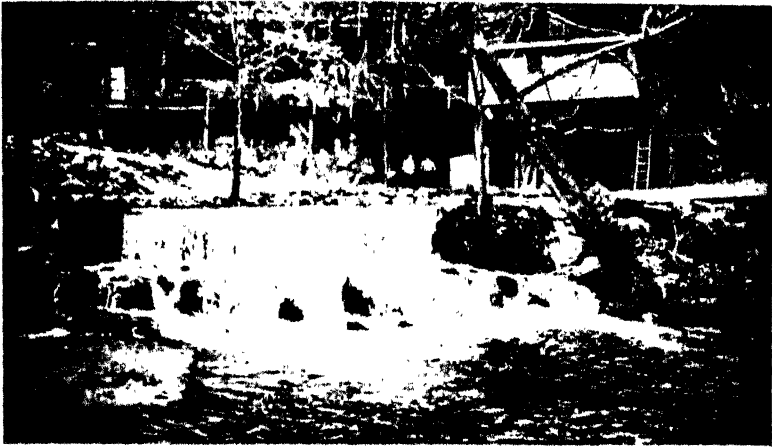
GREER SPRING, OREGON COUNTY
Lower outlet of spring



HAHATONKA SPRING, CAMDEN COUNTY



HAZLETON SPRING, TEXAS COUNTY
Part of spring branch

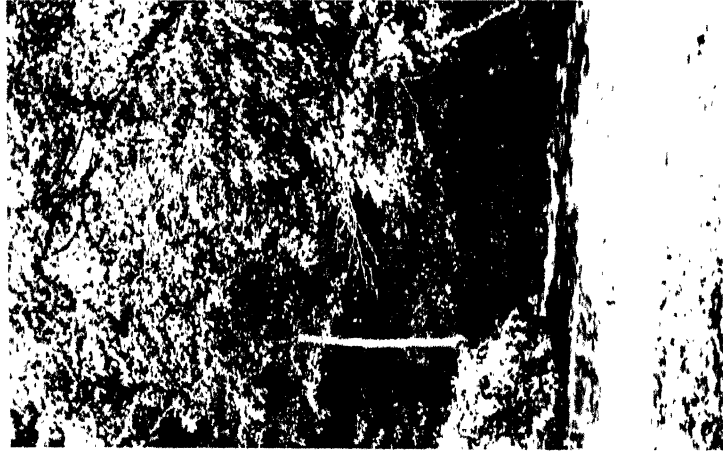


HODGSON MILL SPRING, OZARK COUNTY



KRATZ SPRING, FRANKLIN COUNTY

Head of spring



PREWETT SPRING, TEXAS COUNTY
Head of spring



ROARING RIVER SPRING, BARRY COUNTY
Head of spring



ONANDAGO SPRING, CRAWFORD COUNTY
Head of spring



RELFE SPRING, PHELPS COUNTY
Head of spring



ROUND SPRING, SHANNON COUNTY

Head of spring



STONE MILL SPRING, PULASKI COUNTY

Head of spring



SLABTOWN SPRING, TEXAS COUNTY, LOOKING DOWN SPRING BRANCH
Note abundance of *Rorippa Nasturtium-aquaticum*



TOPAZ SPRING, DOUGLAS COUNTY
Head of spring



TOPAZ SPRING, DOUGLAS COUNTY
Part of spring branch



TURNER'S MILL SPRING, OREGON COUNTY



ROUND SPRING, SHANNON COUNTY



TURNER'S MILL SPRING, OREGON COUNTY



TWIN SPRINGS, DENT COUNTY
Head of spring



TWIN SPRINGS, DENT COUNTY
Spring branch

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